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ABSTRACT

The term "teacher enhancement" is recent; however, its underlying goal--to improve, broaden, and deepen the disciplinary and pedagogical knowledge of elementary and secondary teachers employed in public schools--has been addressed by educators and educational policymakers in the past, usually through the mechanism of inservice training. This report presents a perspective on teacher enhancement programs over the last four decades. Chapters include: (1) "Historical Perspectives on Current Teacher Enhancement Programs in Science and Mathematics" covering the period before the 1950s to the 1990s; (2) "Current Teacher Development/Enhancement Programs in Science and Mathematics"; and (3) "What Evaluations Tell Us about the Impact of Teacher Enhancement Programs". Appendices include lists of teacher enhancement programs and teacher enhancement programs with evaluation components. (JRH)

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Teacher Enhancement Programs:

A Perspective on the Last Four Decades

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Prepared by Westat, Inc.

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Teacher Enhancement Programs:

A Perspective on the Last Four Decades

Prepared under Contract
#SED 92-55369

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June 1995

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Chapter 1. Historical Perspectives on Current Teacher Enhancement Programs in Science and Mathematics

Before the 1950s

The term "teacher enhancement" is of recent vintage. However, its underlying goal—to improve, broaden, and deepen the disciplinary and pedagogical knowledge of elementary and secondary teachers employed in the public schools—has been addressed by educators and educational policymakers in the past, usually through the mechanism of inservice training. To understand the context in which current teacher enhancement programs in science and mathematics are operating, it is useful to take a brief look at changes and continuities in educational practices and priorities during the 20th century, especially since the end of World War II.

Prior to the depression era, public schooling put little emphasis on academic subjects; fewer than half of all students graduated from high school and the numbers going on to college were small. Furthermore, the majority of those who attended the best colleges had attended private schools. For the great majority of students, and especially the masses of immigrants, most of whom were believed to be of low intelligence, the curriculum was to focus on "health, worthy home membership, vocation, citizenship, worthy use of leisure time and ethical character" (Kirst 1984). A focus on academic content was absent. Instead, there was heavy public support (and federal funding) for vocational education during this period. Gradual change came about during the depression, when the lack of jobs motivated many more students to graduate from high school. The growing interest in more education suitable for the needs of all students coincided with the development of "progressive education" advocated by John Dewey and his followers, which relied on developmental theories to structure children's learning processes. According to Raizen (1993), "progressive education ... became the orthodoxy of American public schools," although it had its share of critics. And while Dewey believed that the principles of progressive education should be integrated into a strong academic curriculum, this notion did not become part of the thinking of the educational establishment in the majority of states and communities, where upper-level science and math courses were seen as "elitist" offerings. Thus, the academic component of education continued to be downgraded, and teacher training, both preservice and inservice, emphasized teaching methods and learning and behavioral theories rather than substantive academic and curriculum issues.

During this period, a parallel development was the gradual professionalization, and later, unionization, of the teaching force. As the older generation of teachers (many of whom had at most a 2-year college education obtained in a teacher-training institution) were succeeded by 4-year college graduates, continuing education, which to some extent fulfills the same function as in-service training and is usually provided by academic institutions during the summer months, became a popular innovation. It exposed teachers to new knowledge and ideas, but it also subsidized the acquisition of graduate degrees by ambitious and motivated teachers. One of the earliest inservice programs was funded at Duke University, where the Duke family had specified that school teachers should be given tuition-free courses for two summers. "Since two consecutive sets of six week courses were available each summer, it was possible for teachers to satisfy two-thirds of the requirements for a masters tuition free. In 1939 and 1940, I was one of the hundreds, probably thousands of teachers who took advantage of this outstanding opportunity" (Meserve 1989). To some extent, inservice training, whether in the form of course taking or participation in enhancement programs, continues to play an important part in furthering teachers' career opportunities to this day, whether for license renewal or promotions and salary increases.

From the 1950s to the 1980s

Between the end of World War II and the end of the cold war, the American educational system was challenged by a series of demographic, technological, political, and social developments. The diverse demands created by these developments were at times inconsistent; they also required major expenditures for state and local governments for which the federal government gradually assumed some responsibility, and they affected elementary and secondary mathematics and science instruction more than other subject areas.

Emphasis on students' academic achievement. The great increase in the demand for higher education that started with the end of World War II, when veterans attended college under the GI Bill of Rights, continued throughout this 30-year period and led to much greater emphasis on academic subjects and student achievement in high school. In earlier years, "general" or vocational education was the predominant mode in many K-12 school systems. The first initiatives to improve the academic content of the high school curriculum, especially in mathematics and science, came from industry. With the end of World War II, some influential corporate leaders, especially those at the General Electric Company (GE), began to plan for major conversions from war-time to peace-time production, which called for trained manpower in scientific and technical fields. GE officials became involved in efforts to improve the weak academic background of many high school teachers, which a review of records obtained from the New York State Department of Education had revealed. A high school teacher fellowship program was set up in 1945 at Union College, which had close ties to GE, and 40 fellows were invited to participate. Program emphasis was on academic content and lectures by prominent scientists, as well as on exposure to GE's production facilities and employment opportunities in the company (Krieghbaum and Rawson 1969). Later, several other institutions (Case, Syracuse, Berkeley), also offered summer programs sponsored by GE. In 1952, GE launched a program at Rensselaer Polytechnic Institute for mathematics teachers, and soon programs were offered at other institutions (Purdue, Stanford) as well. When GE discontinued its summer programs for high school teachers, approximately 2,500 public and private high school teachers had participated; the total cost to GE was in excess of $1.5 million.

Westinghouse, GE's main competitor, began sponsoring a summer program for high school teachers at MIT, and one for guidance counselors at Carnegie Institute of Technology. Other companies also supported teacher training programs during the 1950s, including DuPont, Shell Oil, and Burroughs Adding Machines.

The emphasis on the academic content of the high school curriculum was greatly accelerated by Sputnik, which signaled to the American public and to scientists and policymakers (especially in Congress) that the Soviet Union had equaled or perhaps outpaced America's technological leadership. It was widely believed that this had happened because the United States did not train a sufficient cadre of scientists and engineers; this in turn was partly attributed to American students' inadequate mathematics and science education. These concerns triggered the first large-scale teacher inservice programs sponsored by the National Science Foundation, the NSF institutes, which aimed at increasing teachers' scientific skills and knowledge in their fields.

From its modest beginning with a single summer institute for high school teachers in 1954, the program escalated rapidly; by 1957, over 6,500 teachers were involved, summer institutes were held in all but five states, and funding absorbed 25 percent of the total

NSF budget. In 1959, NSF enlarged the program and included institutes for elementary school administrators and teachers. (Institutes for elementary administrators and teachers were discontinued in 1966.) The program continued to grow until 1965, when there were nearly 450 institutes with 21,000 high school teachers as participants. In the late sixties, the institutes reached their highest level, supporting over 35,000 participants per year; by that time, they had supported 50 percent of all secondary science and mathematics teachers (Lomask 1975; Raizen 1993).

The institutes were extremely popular with the Congress because funds went to every congressional district and most often to nonelite institutions, which seldom qualified for NSF research and fellowship grants. Institute funding was earmarked in the annual NSF funds appropriated by Congress. But despite this congressional support, the NSF institutes came under increased scrutiny in the seventies. Questions were raised about the efficacy of the concepts on which the institutes were modeled, with their emphasis on "top down" instruction by eminent scientists and their focus on subject matter expertise to the neglect of pedagogic technique and learning theory. There was little concern about implementation of institute precepts in the school settings in which the teachers functioned, and little evidence that participation had affected teacher behavior and student learning and achievement. But there were other reasons as well, and they were probably more important than judgments about the program's effectiveness. The teacher institutes became linked to NSF's curriculum development initiatives, which became politically controversial. Furthermore, decreases in school enrollment and concerns about a coming surplus of scientists and engineers also contributed to the decision to phase out the NSF teacher institutes. By 1976, the program received almost no funding.

Changing Concerns and Priorities

Concerns about the quality of U.S. math and science education were temporarily eclipsed by desegregation and civil rights issues, which led to major restructuring of school systems and instructional materials. Teachers needed inservice or enhancement programs to learn to work more effectively with previously underserved students, including minorities and students with limited English proficiency. The focus shifted from secondary to elementary and middle school students. At the same time, because of the controversies and conflicts generated by the Vietnam War and a resurgence of progressive child-centered views, students and activists in urban areas demanded more relevance and individual choice (Bierlein 1993). In response, graduation requirements were watered down or eliminated in some districts. Academic excellence took a back seat to equity issues, and specific math and science requirements were once more considered elitist and inappropriate for the large numbers of students who were unprepared to succeed in these fields. The shift in federal funding priorities contributed to the drastic reduction of NSF funding for precollege mathematics and science programs; NSF saw little reason to argue with these new priorities, although the elementary math and science curricula that had been developed earlier had proved quite successful with some of the targeted populations (Raizen 1993).

The Call for Educational Reform in the 1980s: Excellence and Equity

Before long, the pendulum swung back again. The educational liberalism of the sixties and seventies was challenged by a growing number of critics who felt that education policymakers had neglected the issue of excellence, and who pointed to low achievement levels (as measured by the National Assessment of Educational Progress) and declines in national test scores as evidence of deterioration of the American educational system. Even more concern was generated by the results of international studies of mathematics and science achievement, particularly with respect to 13- and 14-year-olds, which showed American students with lower achievement scores than students in most of the other countries included in the comparisons (National Science Foundation 1992). Given the growing concern about U.S. competitiveness in world markets, these data were especially disturbing. The renewed concern with educational quality and academic achievement triggered a spate of calls for reform by policymakers, scientists, educators, and special task forces.[1] Simultaneously, various groups of educators and policymakers began to work on the development of new standards for mathematics and science teaching and learning.

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[1] Probably most influential was *A Nation at Risk*, the 1983 Report by the National Commission on Excellence in Education. Other important documents were *Science and Mathematics in the Schools*, National Academy of Science, 1982; *Report of the Twentieth Century Fund Task Force on Federal Elementary and Secondary Education* (1983); and *National Education Goals*, adopted by the membership of the National Governors' Association in 1990.

Educational Reform in the 1990s and Implications for Teacher Enhancement

Superficially, the new call for reform might suggest a return to the academic priorities of an earlier period. However, this would be a misreading of what the proponents of the reform movement in academe, professional organizations, foundations, and federal, state, and local government bodies have crafted. Rather, reform combines the call for academic excellence with a commitment to equity; it also seeks to impart to all students knowledge and skills appropriate for successful participation as adults in a society increasingly driven by science and technology. All K-12 students regardless of gender and ethnic or linguistic background should acquire mathematical power and scientific literacy that will enable them to function successfully in today's world of rapid technological changes. To achieve this goal will require major changes in curriculum, instructional practices (many of them reminiscent of the tenets of progressive education), and testing or learning assessment practices. Given the decentralized character of the American educational system, the task is a formidable one. The simultaneous introduction of these changes in individual schools as well as in state and local administrative and supervisory bodies ("systemic change") is believed to be the key to the success of reform.

At present, science and mathematics education are the first targets of systemic reform, and specific goals and methods for these fields have been delineated. Systemic reform

- Involves all segments of a school system, from kindergarten through the 12th grade, with the elementary school years seen as especially important for the acquisition of mathematical power and scientific literacy by all students.
- Includes new standards that have been adopted for mathematics and science education.
- Requires ongoing professional development for teachers directed at leading students to think, reason, and make discoveries; promoting group work; and working with heterogeneous classrooms, rather than emphasizing lectures, textbooks, memorization of facts, or grouping of students by ability levels.[2]

The bulk of Chapter two is devoted to a description of the characteristics, goals, and approaches of today's teacher enhancement programs, which seek to enable teachers to play their essential role in carrying out current reform efforts.

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[2] See especially *Professional Standards for Teaching Mathematics*, published by the National Council of Teachers of Mathematics, Reston, Virginia, in March 1991, and *National Science Education Standards (Draft, November 1994)*, National Research Council, Washington DC.

Examples of Teacher Enhancement Programs in the 1950s and the 1990s

Differences between teacher enhancement programs of the past and those today can be illustrated by changes in the experiences of teachers at professional development activities in the 1950s and today.

Early 1950s. Mary, a science teacher, attends one of the new summer institutes offered for high school teachers. The format and content of the institute have been developed by experts and address subjects that they feel it is important for teachers to know.

For 6 weeks, she and other teachers from different schools attend lectures on a college campus and learn more about science from leading experts in the field. New findings in biology are presented, as well as basic skills for those who need extra support. Mary also learns to use a new science curriculum developed by staff at the HPQ Scientific Publications Corporation, designed to match their textbook series. She receives a sample of the HPQ curriculum units to take with her. These units have been carefully designed with step-by-step instructions and are proudly advertised as "teacher proof."

Mary returns to her school having learned many new facts about biology and gained a good review of some of the basic scientific knowledge she already possessed. She has increased confidence in her understanding of science and, if there is time to try out the new curricular units, she is sure that she will be able to follow the directions and give her students all the right answers.

Early 1990s. Susan, a science teacher, applies and is accepted into a teacher enhancement program. The program, a summer institute, was designed through the collaboration of scientists, science teachers, and classroom teachers in her school district.

The goals of the program are to increase teacher knowledge, transfer new skills to the classroom, develop curriculum units, and create teacher leaders. As part of the application process, she has had to submit a letter of support from her principal that includes a commitment of resources and time to allow her to apply what she has learned at the institute to her school when she returns.

Susan spends 4 weeks learning from scientists who function as program facilitators and from teachers from her district who participated in the program last year. In the program, Susan and other teachers in the institute participate in multiple learning activities, such as lectures, hands-on activities, and small group discussions. The teachers also get training in how to create and teach a unit in a new curriculum, a curriculum based on Project 2061 and the newly developed science standards. The teachers also have the opportunity to practice teaching the units they design while they are still in the summer institute.

After the program, Susan works with her principal to incorporate what she has learned into her teaching and the school's science curriculum. She also presents what she has learned to other teachers, encourages them to attend the next summer institute, and invites them to observe her class. She participates in several followup activities during the year to help her implement the program, and she is hoping to become one of the returning teachers who supports others in the program the next summer.

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Chapter 2. Current Teacher Development/ Enhancement Programs in Science and Mathematics

The term "teacher enhancement" as used in the 1990s is similar to the term "school reform." Although apparently simple and easy to understand, it is a single label that covers a wide variety of services and experiences offered to teaching professionals. In this section we describe the variations in teacher enhancement programs existing today.

First we look at the nature of the programs, describing them in terms of both focus and structure. Second, we examine the goals of these programs, describing the range of impacts that have been expected. Finally, we turn to a description of some recent or ongoing efforts to illustrate more clearly the many types of teacher enhancement projects funded in the 1990s. These projects have been selected to provide what might be called "the flavor" of what is happening, rather than a comprehensive overview of the many efforts underway.[3]

Current Dimensions of Teacher Enhancement Programs

Today's teacher enhancement programs can be described in terms of two general dimensions: their focus and their structure.

Focus. "Focus" as used here means the content of the teacher enhancement program or what types of knowledge and skills are being taught. Arguments over focus have centered around the recurring issue of how much weight to place on content (subject matter) versus the process of instruction. Today, as in the past, these factors are given differing priority, based on who is offering the program and the gap the program is designed to fill.

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[3] The studies included in Chapters 2 and 3 (and detailed in Appendices A and B) were located through the following avenues: reading literature syntheses and other documents pertinent to the subject of teacher enhancement programs in math and science, and following up on programs cited that included some mention of program evaluation or program outcomes; conducting an ERIC search for relevant articles on the topics of evaluations of teacher enhancement programs in math and science; conducting "snowball" searches where articles discussed or cited in one document seemed worthy of followup for more detailed review; and reviewing documents that describe and/or evaluate federally funded teacher enhancement programs.

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Programs stressing content see the role of teacher enhancement efforts as that of providing teachers with advanced knowledge in specific areas. Typically this knowledge is offered through research and other experiences in applied settings. Some of these efforts may be university based; others are placed in or closely linked with places where practicing scientists (or mathematicians or engineers) work. Frequently the primary pedagogical approach mirrors hands-on techniques, but it is the content of instruction rather than the process of instruction that receives the greatest stress.

Advocates of process stress the need to reform the teaching/learning interactions, emphasizing the importance of a constructivist approach. Such programs typically are designed to provide teachers with skills to use hands-on, inquiry-based instruction and to be a coach or facilitator rather than a lecturer. Depth is stressed over breadth, problem solving over memorizing facts.

Structure. "Structure" as used here means the approach to planning and delivering teacher enhancement programs. There are two schools of thought that coexist today with regard to the structure of teacher enhancement programs. Although an oversimplification, these schools can be contrasted in terms of the extent to which the experiences are expert-driven or driven by teachers themselves. (This contrast shares many characteristics with the top-down, bottom-up debate that continues to rage with regard to school reform.) At the extreme, the expert-driven model involves experiences that are directed by experts (in mathematics and science, these experts are frequently practicing scientists in academic or applied settings) who share their knowledge, work environment, and work experiences with teachers who come to learn with and from them. Lieberman characterizes this method as the conventional approach, which defines staff development as "a transferable package of knowledge to be distributed to teachers in bite-sized pieces" (1995, p. 592).

At the other extreme are teacher-driven experiences, which aim as much at changing culture as gaining new skills and knowledge. These tend to be of relatively long duration and to embed the development activities in the teachers' place of work, the school setting itself. Proponents of the teacher-driven approach see schools as learning organizations and believe real change requires collective problem solving, practice, and creating a culture of inquiry (Lieberman 1995).

In addition to philosophy, characteristics that distinguish these two approaches, and may even vary within them, include intensity, target population, and geographic scope.

Intensity. Professional development activities range from short, single-shot experiences to multi-year programs. Some teacher enhancement programs are short-term workshops or inservice days in which a particular technique is explained or a new policy introduced. Others are longer term summer workshops or mentorships that are several weeks in duration and may include year-round followup activities. Still others are based on a multi-year format, with teachers graduating through stages. These may include alternating cycles of learning and application across a 2- to 3-year period.

Target population. Programs vary in the extent to which they target individual participants versus teams of participants from a single school or a site. In the latter case, the teams may include several teachers from the school, may be more heterogeneous and involve teaching, administrative, and even community personnel, or may serve multiple individuals from the same site over consecutive training sessions.

Geographic scope. Programs vary in whether they are targeted at the local, regional, or national level. While teacher-directed programs are almost always local, those based on the expert model can be local, regional, or national in scope.

Current Goals of Teacher Enhancement

Programs also vary in terms of their goals—especially the extent to which the teacher rather than the student is the primary target of program impact. While in general terms all programs acknowledge that the goal of teacher enhancement is to provide improved instruction that will contribute to improved student achievement, many have traditionally considered student achievement to be too distal or affected by too many different factors. Changing or assisting teachers is seen as an end that is important, and sufficient, in and of itself. Potential goals follow:

Increasing teacher knowledge. A primary goal in teacher enhancement continues to be increasing teacher knowledge. One reason for the need to increase teacher knowledge is that mathematics and science teachers, especially those who teach elementary students, often receive inadequate preparation in these subjects in their undergraduate education. Because of inadequate preparation, many teachers do not feel confident about their teaching abilities in mathematics and science and often do not enjoy teaching these subjects. Thus, many programs seek to increase teachers' confidence by giving them the opportunity to understand more about math or science and more about methods for teaching the subjects.

Another reason for increasing teacher knowledge is that teachers today are expected to be knowledgeable and capable in areas that they may not have dealt with as undergraduates, such as computers, environmental issues, and new technologies. Teachers today also need help in assuming roles that are nontraditional for them, such as assessment development and becoming leaders in their schools. Given changes in technology, curriculum, and teaching methods, many argue that it is not feasible to completely prepare a preservice teacher for a lifetime of teaching (e.g., Meserve 1989).

Providing teacher renewal and the opportunity for networking. Another important aspect of the current reform movement is renewal and the opportunity for continued networking. Although many teacher enhancement programs do not cite networking as a goal, many stress renewal and have networking components. Networking with others is often used to decrease teacher isolation and increase professionalism by increased opportunities for teachers to interact with one another and other professionals to share their experiences and knowledge. A great deal of networking takes place through contacts with others in the teacher enhancement programs and through professional development activities, such as attending conferences. Some programs also support and encourage teachers to network through computers. E-mail computer networking is one of the major followup activities used by professional development summer institutes that serve participants from across the Nation. Through these contacts, teachers have the opportunity to learn about new developments in their field, to keep up with other program participants and mentors, and to share their experiences.

Increasing leadership and empowerment. Many programs emphasize the development of teacher leaders.

Teacher leaders are very useful in reaching out to and teaching other teachers. Enhancement programs that develop teacher leaders can indirectly reach many more teachers when teacher leaders share their knowledge with others.

Teacher enhancement programs also may serve to empower teachers. In addition to increasing teacher empowerment through leadership development, many current programs emphasize teacher empowerment through their methods of teaching teachers. An assumption in many of the new programs is that teachers should have direction and control over their own learning and professional development (Shavelson et al. 94). Instead of top-down programs in which teachers passively receive knowledge, the emphasis today is on the active participation of teachers in their own learning. When teachers have more ownership of their education, they are expected to be more invested in the changes brought about by it.

Changing classroom practice. Changing classroom instruction is another major goal of teacher enhancement programs. Most programs help teachers in some way to apply what they learned in the program to the classroom, for example, by giving teachers materials or equipment for classroom activities or having teachers write detailed plans for how they intend to use what they learned in their classroom. Some programs focus on this aspect more directly and give teachers the opportunity to field test what they have learned with students in the program and/or give teachers coaching or feedback in the use of new instructional tools or materials in their home classrooms.

Increasing student interest and achievement. An underlying goal of teacher enhancement programs is to increase students' interest in mathematics or science and to improve achievement. In some programs, this is often not an explicitly stated goal; however, through improved curricula and improved teacher knowledge and teaching methods, it is expected that students will benefit from these improvements. Programs aim both at providing instruction that will help students become more "world class" performers and at creating a more scientifically literate society.

Enhancing minority participation. An even more indirect goal of programs is to increase participation of minorities in science and mathematics. Some teacher enhancement programs are designed to attract more students who are members of groups that do not usually pursue careers in science or mathematics, such as minorities, females, and persons with physical disabilities. Some programs have required that teachers who are part of minority groups be involved, while others have developed models for inservice that are particularly encouraging to the development of leaders among underrepresented groups. The idea behind some of these efforts is that teacher leaders from underrepresented groups will encourage students from these same groups to become more interested in mathematics and science.

In Chapter 3 of this review, we return again to these goals and examine the extent to which evaluation studies have looked at, and provided support for, the efficacy of teacher enhancement programs with regard to them. Selected teacher enhancement programs identified in the literature review are described and classified according to these goals in the appendices. Appendix A covers programs funded through various sources; Appendix B describes those programs with an evaluation component.

A Look at the Types of Programs Currently Supported by Major Funders/ Supports of Teacher Enhancement Programs

In this section we present an overview of teacher enhancement programs as they are being conducted today. Our review is naturally selective, as the amount of activity directed toward professional development is extensive. (For example, in the FY 1994 federal budget alone, professional development programs at $419,988,000 represented almost 50 percent of the total funds allocated for elementary and secondary mathematics education.)

Our focus for this review is on the programs supported and encouraged through funds provided by the federal government and major private organizations, such as many foundations and the business community.[4] We examine these programs in light of the dimensions of practice and goals discussed earlier and attempt to identify the major trends or flavors of the activities.

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[4] We have not included specific discussion of the many efforts that are funded at least in part by state and local funds. This should not be interpreted as a lack of recognition of the importance of such efforts but rather the result of the difficulty of covering such efforts in any depth. Further, many of these projects also receive funding through the sources reviewed here.

Federal Agencies

Many federal agencies are involved in teacher enhancement, and interest has increased as the mission agencies have looked for ways to demonstrate their contribution to the federal education agenda. Major players include the Department of Defense (DOD), the Department of Education (ED), the Department of Energy (DOE), the Department of Health and Human Services (HHS), the National Aeronautics and Space Administration (NASA), and the National Science Foundation (NSF).

Federally supported programs include both the expert-driven and teacher-driven models, with the mission agencies relying more heavily on the expert approach. All have embraced the idea of systemic reform and conceptualize teacher enhancement as part of a broader reform package. One major source of difference between the agencies is in the extent to which they make use of their own talents in providing professional development versus seeking proposals from other sources. The mission agencies tend to capitalize more on their own talents, while the Department of Education and NSF are more field-based.

A wide range of goals are espoused, with improving teacher knowledge and classroom practice being universally accepted. Increasingly, attention is being devoted to the goal of improving student outcomes, and agencies such as NSF and ED are struggling with how best to measure impact in this area. The attention to student outcomes is largely a result of external pressures (such as a recent report by the General Accounting Office (GAO) and the requirements of the Government Performance and Results Act); the extent to which the agencies themselves feel that such goals are applicable and reasonable remains unclear.

A closer look at programs supported by some of these agencies is presented below.

Department of Education. Of the federal agencies, the Department of Education supports the largest teacher enhancement and preparation effort. In fact, over half of the federal budget for teacher enhancement and preparation is provided by ED, primarily through the Eisenhower State Mathematics and Science Program (Committee on Education and Human Resources 1993).

These activities are directed more at providing funding streams than at supporting a certain type of program. (Encouragement of more systemic efforts is, however, increasing.) The three components of the program are state leadership activities, "flow-through" funding to school districts, and grants to institutions of higher education. The majority of the funding goes to school districts to fund professional development activities. Traditionally, most of the funds have supported "low-intensity" inservice education, with an average of 6 hours of training each year for each participant (Knapp et al. 1991). Some of these funds also support professional development that takes place out of the district, such as participation in professional associations. Professional development activities sponsored by the program have enabled large numbers of teachers to learn about reform activities, network with other teachers, and enhance their interest in teaching (Knapp et al. 1991).

This program was revised somewhat in recent legislation that reauthorizes appropriations under the Elementary and Secondary Education Act of 1965 (Conference Report 1994). Central in this revision was allowing these funds to be used for professional development in subjects other than mathematics and science. As envisioned in the legislation, the main purposes of this program are

- To make it possible that teachers and other educators have access to high quality professional development in the core subjects that incorporates state standards and is of sufficient duration and intensity; and
- To provide access for teachers and, if appropriate, administrators, other staff, personnel services, and parents to professional development that is tied to state content and performance standards, incorporates current research, involves quality academic content and pedagogical components, includes ways for teachers to meet the needs of a heterogeneous student population, is of sufficient duration and intensity to have a long-term impact on teachers, is incorporated into school life, and fosters an attitude of ongoing improvement in the school (Conference Report 1994).

Other noteworthy purposes of the program are to provide professional development programs that help teachers encourage and enable parents to be involved in their children's education and to train teachers in new uses and ways to apply technology to augment student learning.

The Department of Education views professional development as a key factor in education reform. And, the approaches being encouraged share many of the features of a culture of learning, even though existing practices are quite varied. According to the

Department of Education's Draft Mission Statement (October 1994), high quality professional development

- Focuses on teachers as central to school reform, yet includes all members of the school community;
- Respects and nurtures the intellectual capacity of teachers and others in the school community;
- Reflects best available research and practice in teaching, learning, and leadership;
- Is planned principally by those who will participate in such development;
- Enables teachers to develop expertise in content, pedagogy, and other essential elements in teaching to high standards;
- Enhances leadership capacity among teachers, principals, and others;
- Requires ample time and other resources that enable educators to develop their individual capacity and to learn and work together;
- Promotes commitment to continuous inquiry and improvement embedded in the daily life of the schools;
- Is driven by a coherent long-term plan that incorporates professional development as essential among a broad set of strategies to improve teaching and learning; and
- Is evaluated on the basis of its impact on teacher effectiveness, student learning, leadership, and the school community, and uses this assessment to guide subsequent professional development efforts.

The last principle of professional development illustrates the Eisenhower program's recent emphasis on linking teacher enhancement to student achievement.

An example of a project funded by the Eisenhower program is the Chemistry Camp Inservice for Middle School Teachers at Chicago State University. The CHEM CAMP program includes master teachers, inservice teachers, and students. Master teachers participated in the program at an earlier time and subsequently recruited teams of teachers from their schools. The camp is a 4-week summer program involving content instruction, laboratory practice, and practice teaching of middle school students. The program was designed to provide training in how to implement a program of hands-on chemistry experiments for students. Goals of the program are to change teachers' attitudes toward science, provide more content in chemistry, and provide pedagogical strategies. This program also provides networking opportunities for teachers and leadership experiences for the mentor teachers, and it includes a high rate of minority participation.

National Science Foundation. The National Science Foundation supports teacher education through two principal means—its Teacher Enhancement (TE) program and its systemic reform efforts. The goal of TE is to increase, expand, and deepen the content and pedagogical knowledge of teachers, administrators, and others who are influential in the science, mathematics, and technology education for pre-kindergarten through 12th grade students (Teacher Enhancement and Development 1994). In order to accomplish this outcome, TE emphasizes systemic change, teacher enhancement, expansion and replication projects, dissemination, and other activities such as developing resource materials. Although there are a variety of different projects included in TE, the vision for all projects includes the following:

- Recognition of the critical role outstanding teachers play in promoting competence, interest, and enthusiasm for study in these fields;
- The need for school counselors, parents, community leaders, and others to provide a supportive environment; and
- The requirement that school administrators and educational leaders commit themselves and the resources they control to ensuring excellence in education for all students.

NSF-funded teacher enhancement projects vary widely, but share a focus on the classroom as the key to educational improvement. Teacher enhancement projects give participants a thorough exposure to content and pedagogical knowledge, provide knowledge of quality curriculum materials, and provide followup support that is necessary to implement classroom improvement. Leadership beyond the classroom is also emphasized, such that the impact of the project is felt beyond the individual classroom. Another general characteristic of the projects is that they are to involve all of the persons who are influential in students' education—principals, scientists, curriculum developers, etc. The objective of the TE projects is to develop and maintain a cadre of leaders in science, mathematics, and technology education.

Increasingly the TE programs are designed to involve a whole school, school district, group of districts, area, or constituency in which schools are connected by a shared need or decision-making process. These projects are expected to involve policymakers in addition to those who implement and are affected by policy. Particularly encouraged are programs in communities with large numbers of disadvantaged students, underrepresented students, and/or students who have traditionally received a low level of support. A new program in the TE area, called the local systemic initiative, stresses the delivery of teacher enhancement within the context of a district-focused reform effort. This program, like those described by Lieberman (1995), explicitly stresses the importance of both formal and informal development activities.

Systemic reform efforts include teacher enhancement as one of the components believed to be essential for bringing about

An example of a TE project is the Marine Science Teacher Education Program (MSTEP).[5] The program is designed for teachers of grades 5 through 12 in the Los Angeles Unified School District. The district is a partner in the program. MSTEP includes a 6-week summer workshop and six 1-day followup sessions. It incorporates concepts contained in the California Science Curriculum framework. Overall program goals are (1) "to promote the implementation of an integrated science curriculum (grades 5 through 12) based on marine science in a large, urban school district" and (2) "to get participants excited about science and to carry this excitement back to their schools." More specific objectives of the program are to have participating teachers create and teach at least one thematic science unit based on marine science during the program and act as instructional leaders in their schools and throughout the district to promote thematic instruction. Although it is not stated as a goal, teachers are provided some networking opportunities. Teachers in the program are involved in field work at the Wrigley Marine Science Center on Catalina Island, are presented marine science curricula, and are involved in developing an implementation plan for their science unit to be taught in the upcoming school year. The MSTEP program promotes a conceptual or thematic approach to science, involves teachers and students in hands-on learning, and emphasizes inquiry directed by students and active science investigation. The program has a final followup session that is district-wide and is developed and implemented by participants. Teachers who graduate from the program may return to subsequent summer workshops as presenters.

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[5] Information about this training program was collected as part of a recent multi-agency study conducted by the Dissemination/Evaluation Working Group (DEWG) and the NSF of best practice teacher enhancement/development programs (Frechtling et al. 1994).

change. Teacher enhancement is combined with policy change, curriculum revision or development, changes in assessment, and development of school-community partnerships. The goal of these programs is to provide a highly challenging instructional experience for all students. Special attention is directed to those traditionally underrepresented in the mathematics, science, and engineering fields. In many ways, the TE and systemic reform programs of the Foundation are approaching each other, as systemic reform almost always includes teacher enhancement, and teacher enhancement is beginning to require a systemic focus.

A recent study documents the activities of the TE program from 1984 (the year it was initiated) through 1989 (Abt Associates 1993). The most frequently cited instructional approaches by program Principal Investigators were hands-on activities, small group discussions, and the development of curriculum. The most frequently cited goals were increasing teachers' knowledge of science and mathematics subject matter, giving teachers hands-on teaching exercises, and creating ways for teachers to augment student interest in these subjects. In more recent years, the goals of developing teacher skills for improving student problem solving and increasing student interest in science and mathematics have become more important.

In comparison to the Eisenhower program of the Department of Education, the NSF TE program is more targeted and competitive. The NSF more directly specifies the reform efforts that it will support, and it funds fewer grantees than the Eisenhower program.

National Aeronautics and Space Administration. NASA programs are designed to make use of NASA's unique facilities and resources. The Teacher Enhancement and Preparation programs are largely expert-driven and are conducted through workshops, classes, seminars, and other means (National Research Council 1994). The main goals of the NASA Teacher Enhancement and Preparation programs are to increase teachers' knowledge about math and science using NASA-related topics and to show teachers how to integrate this knowledge into teaching.

In many NASA programs, teachers have the opportunity to see NASA research first hand. The program is designed to help teachers, using NASA-related topics, to create and use lessons and experiences that will stimulate and engage students. NASA programs also are designed to have teachers who participate inform and help their colleagues use what they learned, help students become more interested in math and science, and increase student performance. Student performance is seen as an indirect effect of improving teachers' knowledge and teaching skills, and one that may be more difficult to attribute only to the NASA program. Throughout all NASA programs there is also a goal of increasing the participation of groups underrepresented in science, mathematics, engineering, and technology.

Some NASA programs are short term, such as the Aerospace Education Services Program (AESP) in which aerospace specialists visit schools to make presentations to students and teachers. Specialists visit at the request of schools and present information on aerospace history and concepts using new technologies and up-to-date teaching practices. The objectives of this program are to disseminate information about NASA, to promote NASA research and development in aeronautics and space, to involve students and teachers at all levels in learning specific to aerospace, and to promote the professional development of preservice and inservice teachers. Aerospace specialists are also involved in the Urban Community Enrichment Program (UCEP) in which they collaborate with teachers in implementing an 8-week aerospace program. Core teachers are recommended by school principals and are selected by superintendents. These teachers then lead an interdisciplinary team of teachers in conducting the program. The program is designed for middle-level students in urban areas with high minority populations to gain exposure to space topics. Other objectives of the program are to create teacher/parent involvement in aerospace education; to increase teacher and community awareness of NASA resources and programs; to bring attention to multicultural contributions to aerospace; to make students aware of careers in science, technology, and mathematics; and to help students increase their skills in writing, reading, and mathematics (National Research Council 1994).

Other NASA programs provide limited experiences over the summer. Two such programs are the NASA Educational Workshops for Math, Science, and Technology Teachers (NEWMAST) for secondary school teachers and the NASA Educational Workshops for Elementary School Teachers (NEWEST). Both programs are nationally competitive. Teachers in these 2-week programs go to a NASA center to learn about aeronautics and space and are offered a variety of experiences, such as laboratory research, presentations, and the opportunity to "shadow" scientists. Teachers work both on individual and

An example of NEWEST is the program at NASA Langley, funded both by NASA and the National Science Teachers Association (NSTA). Participants for the program are selected by the NSTA. The program has worked toward having a diverse group of participants and has been successful in achieving minority participation. NASA Langley has a 2-week summer training program designed to help elementary teachers learn about aerospace content and give teachers activities and supplies to teach this content in elementary school. Teachers learn through presentations and hands-on activities and do many activities in cooperative teams. What the teachers learn, the facilities, and materials are all related to the aeronautical and atmospheric areas of research at NASA Langley. The program also encourages networking and participation in the NSTA. Teachers are not involved in designing the program; however, their input is used for future consideration and to make some changes, such as allocating more time to a particular activity. Following the program, teachers can get ongoing support if they request it.

team projects in order to increase their knowledge and motivate them to use what they have learned in the classroom. Objectives of the NEWMAST and NEWEST programs are to acknowledge and involve exceptional elementary and secondary teachers and to give teachers leadership training to update and renew their backgrounds and skills in science, mathematics, and technology (National Research Council 1994).

Department of Energy. The DOE is a relatively recent player in teacher development (Raizen and Loucks-Horsley 1994). It began new initiatives and increased its funding to precollege programs in math and science in response to a 1989 planning conference on how it could respond to the problem of poor education in our country that was highlighted in *A Nation at Risk*. In its efforts to improve mathematics and science education, the DOE has established two long-term goals:

- Arming teachers with a better grasp of subject matter and more effective strategies for teaching science and mathematics through teacher enhancement programs; and

- Improving student outcomes, particularly their achievement and persistence in pursuing technical fields (Raizen and Loucks-Horsley 1994).

To obtain these goals, DOE focuses on the unique resources of its laboratories, creating partnerships with others at the federal and state levels, in businesses, in higher education, and in the community; targeting minorities and groups who are underrepresented in science and engineering; funding systemic reform efforts; and demonstrating cutting-edge research and practice with an emphasis on hands-on, experiential learning (Raizen and Loucks-Horsley 1994).

DOE, through its laboratories, offers two types of teacher enhancement programs: teacher development programs and teacher researcher programs. Teacher development programs provide a variety of experiences for teachers in the region of each participating laboratory and nationally. These programs are 2 to 4 weeks in length and serve approximately 30 participants per session. Programs provide exposure to new content areas and increasingly support teachers developing ways to transfer and apply their new knowledge to their classrooms. Inquiry-based teaching is modeled, if not taught.

An example of a TRAC program is the Teacher Research Associates Program at Los Alamos National Laboratory (LANL). Goals of the program are the same as for the national TRAC program. Networking is not an explicit goal, but it is a component. The Los Alamos program includes teachers from across the country in addition to a few local teachers. Teachers in the program participate in an 8-week research experience at the LANL. Teachers are matched with mentors based on the mentor's project and field and the teacher's interests. Teachers work with mentors on projects that include all parts of the research process, from collecting data and doing hands-on experiments to analyzing data and writing papers. They learn about new technologies through a variety of means, including direct study, research, and hands-on experience.

The Teacher Research Associates (TRAC) programs aim more at providing participants with a research experience and close mentoring by a laboratory scientist (Vivio and Stevenson 1992). Following completion of the program, teachers are to share what they learned with their colleagues and students. These programs are designed to be long-term experiences, and most summer programs last for 8 weeks. In a typical program, about 80 percent of a teacher's time is spent in the research component of the program, while 20 percent is spent going to seminars, lectures, group meetings, and other activities.

Similar programs, providing intensive research experiences, are offered by HHS.

Foundations

Foundations are a major player in the teacher enhancement arena, and many projects targeted at local school districts or regions have been supported through foundation money. Foundations active in the teacher enhancement area include the Woodrow Wilson Fellowship Foundation, the Pew Charitable Trust, and the Ford Foundation, among others. Although the number of programs offered makes it difficult to generalize, many foundations tend to emphasize teacher empowerment in their programs and have followed the lead of federal agencies in attempting to deliver professional development within a systemic context. Like the federal agencies, goals for these efforts range from a variety of teacher outcomes to impacts on student learning. Even more than within the federal agencies, however, there appears to be some debate as to whether or not the fruits of these efforts should and can be assessed in terms of student achievement. The goals of teacher renewal, creating a community of learners, and cultural change are frequently more prominent and justified as highly valued ends in and of themselves.[6]

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[6] These issues were addressed in the session "New Dollars for the Professional Development of Teachers: What Do We Know About How to Spend Them Well?", a symposium at the American Educational Research Association annual meeting, April 18-22, 1995, San Francisco, CA.

The Woodrow Wilson Fellowship Foundation sponsors the National Leadership Program for Teachers (NLPT). This ongoing program trains expert middle and high school teachers and helps them train other teachers throughout the country. The NLPT is based on the idea that experienced teachers have much to contribute to educational reform because they are in a better position than researchers or theorists to know what will work in the classroom. They also are more often trusted by other teachers than are outsiders. The goals of the program are to provide a heavy concentration in science, math, and history; expand teachers' knowledge; increase teachers' professional status; and promote teaching methods to stimulate the learning of all students and involve them in their learning. The program begins with a summer institute at Princeton University in which teachers work collaboratively with faculty and researchers to create up-to-date teaching materials that emphasize new developments and student involvement in their own learning. Teachers also have the chance to observe each other teach. Following the institute, the expert teachers have the opportunity through small grants to be involved in outreach projects in their own communities. Expert teachers also may disseminate what they learned in the institute through presentations at Teacher Outreach 1-week institutes (TORCH). Expert teachers are chosen from the institutes to be part of traveling teams of teachers who present 1-week institutes to groups of other teachers. A third component of the program is a followup session of at least 1 day for teachers to renew their relationships with other teachers and to share their experiences.

An example of an effort funded by foundations is the UMC project. The UMC project established 16 collaboratives, with a core structure of a host agency, a set of goals, a group of eligible teachers, activities, and some participation from institutions of higher education, business, and the school district (Webb and Romberg 1994). Aside from the basic structure, collaboratives were to form their own models based on local needs, resources, and interests. Collaboratives varied from site to site, but all involved collaborations between teachers, administrators, business, and college and university educators. Each collaborative was designed to help secondary school teachers in inner-city schools by reducing their isolation, increasing their enthusiasm, informing them of new developments in mathematics, and promoting new teaching methods that incorporated ideas from the current reform movement. For example, some workshops in the program emphasized moving away from the idea that learning only means memorization and toward the idea that learning means "investigating, formulating, representing, reasoning, and using strategies to solve problems, then reflecting on how mathematics is used" (Webb and Romberg 1994, p. 3). Teachers were taught how they could get students to discuss mathematics, propose ideas, make arguments, and present strategies.

The Ford Foundation initiated the Urban Mathematics Collaborative (UMC) in 1984. The purpose of the UMC was to make mathematics education better in inner-city schools and to find new models to meet teachers' professional needs (Webb and Romberg 1994). The initiation of the UMC grew out of criticism in the early 1980s of science and mathematics education in the United States. A premise of the program was that mathematics teaching would improve if the status of teachers improved and if there was a structure for teachers to learn about advances in mathematics education and applications in business and industry. Because inner-city teachers are often isolated, an important goal was to connect these teachers with mathematicians, reformers, administrators, and other teachers.

Private Business and Industry

Corporate initiatives in science and mathematics take many different forms, from short-term support for conference attendance, to providing technical advice and assistance, to supporting more broad-based training (Rigden 1994). Many private business and industry programs are similar to programs of NASA and DOE in that they employ an expert mentor model and make use of unique resources available at research or business sites. Teachers learn about business or industry firsthand by spending time on job sites with mentors. Many of these programs also involve learning new technologies and research. These programs frequently aim at another kind of student outcome—helping teachers to prepare students to be good workers and scientifically literate citizens.

The Georgia Industrial Fellowships for Teachers (GIFT) was designed for teachers to gain firsthand experience with new technologies and research, applied science, mathematics, and computing; to strengthen ties between education and industry; and to have teachers use in the classroom what they have learned in the program. The program, initiated in 1990, includes paid summer work or research and internship opportunities, in addition to workshops during the summer and school year. An offshoot of this program, MINI-GIFT, is for middle grade teachers and involves work or research and the development of educational materials in informal science education settings such as zoos and museums.

Another example of corporate involvement in teacher enhancement in an applied setting is Industry Initiatives for Science and Math Education (IISME), a nonprofit organization that seeks to improve mathematics and science education in the San Francisco Bay Area. The program is a collaboration between the Lawrence Hall of Science at the University of California and more than 60 industry and government sponsors. The goals of IISME are to "increase the nation's scientific and technical talent pool, improve the quality of mathematics and science education for all students, and promote mathematics and science literacy in the population at large" (IISME Shaping the Future 1995). In the IISME program, a variety of programs are offered to teachers, such as the Summer Fellowship Program, the IISME Academy, IISME VISION, and several others. The core program of IISME is the Summer Fellowship Program for middle and high school teachers. These fellowships allow teachers to work for 8 weeks in industries, government agencies, and university research laboratories. The fellowships originally were only for secondary school teachers, but they have expanded to include elementary and middle school teachers. Starting in 1994, IISME started a new aspect of the program in which teachers are divided into Community Groups at or near their company placements. These groups provide support for participating teachers and allow for networking opportunities. The IISME program also has services during the school year through the IISME Academy.

The Exxon Education Foundation is supporting a major effort to improve the K-3 Mathematics Education Program, based on the National Council of Teachers of Mathematics (NCTM) Professional Standards (Dimensions 94: A Report on Exxon's 1994 Contributions 1995). The program trains math specialists who then train other teachers and work with children. Specialists also promote quality math teaching in the schools, and many conduct programs for parents and students (Exxon Education Foundation 1994).

Chapter 3. What Evaluations Tell Us About the Impact of Teacher Enhancement Programs

Introduction

It is clear that teacher enhancement programs are popular and valued widely, but what do we really know about their impacts? A recent report by the General Accounting Office asserts that the answer is really very little. The 1994 GAO report on the Department of Energy's Precollege Math and Science Education efforts was highly critical, chastising the Department for both its failure to conduct sound evaluations and the lack of data linking participation in teacher enhancement programs to one specific outcome, student achievement (GAO 1994). GAO supported its 1994 conclusions about the lack of efficacy of teacher enhancement programs by citing studies previously reviewed in its own 1984 report (GAO 1984). While there are some flaws that can be cited with regard to this report (for example, the contention that there is stronger evidence on the efficacy of curriculum and systemic change efforts than there is on teacher enhancement, and their sole reliance on student outcomes as a measure of program success), the GAO report does sound an alarm, identifying a lack of comprehensive and methodologically sound evaluations.

While this paucity of evaluation literature is disappointing, it is not surprising given the limited resources that have been devoted to evaluation of federal mathematics and science programs in general. As noted in the Report of the Expert Panel for the Review of Federal Education Programs in Science, Mathematics, Engineering, and Technology, "the impact of current Federal efforts in SMET education remains unclear....Federal expenditures are being made with too little overall planning and with inadequate evaluation." In fact, for a majority of federally funded SMET education programs, no evaluation information is available at all (Committee on Education and Human Resources 1993). Furthermore, only recently has there been a clear mandate from the federal government that all federal agencies evaluate their SMET education programs.

In this chapter we present a review of evaluations of teacher enhancement programs using both published and unpublished materials (see Appendix B for descriptions of programs with an evaluation component). The data presented here generally corroborate the GAO's conclusions. Further, they show that few evaluations have even addressed the question of the linkage between participation in a teacher enhancement experience and student outcomes. Where other impacts have been the focus, studies have, by and large, relied on limited, and possibly suspect, methodologies, such as teacher self-report. As stated by Joyce and Showers (1988, p. 127)

"documentation is underused and opinionnaires are overused."

Evaluations of teacher enhancement programs have looked at the following outcomes.

- Were the participants satisfied with the training experience?
- Did the participants acquire new knowledge and teaching skills?
- Were the new skills transferred to classroom practice?
- Did the experience have a positive impact on teachers' feelings of professional renewal and career satisfaction?
- Do teachers feel more empowered and able to take on leadership roles in their home schools and to act as disseminators of information?
- Have students' attitudes toward math and science and their achievement in these areas improved as a result of teachers' participation in programs?

As might be predicted, the majority of studies have looked at the first two outcomes, with fewer addressing the impacts further down the list. In the remainder of this chapter we present our findings from the review of the evaluation literature. Selected studies and their outcomes are presented for illustrative purposes. More detailed summaries of the studies are presented in the appendices.

Participant Satisfaction

A high degree of participant satisfaction is one of the most prevalent findings concerning teacher enhancement programs. Many programs report that through either exit or followup surveys, participants have indicated that the program was a satisfying and positive experience for them.

In general, evaluation studies report these findings in two ways. First, they report respondents' answers to Likert-like scales in which they are asked to rate the degree to which they were satisfied with the program. For example, in the Department of Energy's followup survey to the Teacher Research Associates

(TRAC) program (Vivio and Stevenson 1992), participants were asked in the exit survey to rate their overall satisfaction with the program. On a scale from 1 (very dissatisfied) to 10 (very satisfied), more than 70 percent responded with a 9 or 10, with an average rating of 9. In the evaluation of the Great Starts Mathematics Approach (Jarvis and Blank 1989), 90 percent of the participants said that the program had a major impact in influencing their understanding of ways to teach math.

Program evaluations also report comments made by program participants to illustrate the kinds of reactions received to workshops. Participants in the Eisenhower-funded program Implementing the NCTM Standards for School Mathematics for the 21st Century (Kroll 1990) said that the workshops "excited and inspired" them. The report on DOE's TRAC program (Vivio and Stevenson 1992) included quotes from participants such as the following: "It was very refreshing"; "It gave us a sense of self-worth"; "My thoughts are valuable to someone"; and "Someone is going to listen to me." This is typical of the kinds of responses teachers give to questions about their teacher enhancement experiences.

Teachers in general appear to feel very positively about their experiences in teacher enhancement programs. While these reactions are often reported as overall satisfaction, participants frequently are asked to rate their satisfaction with specific aspects of the programs. These outcomes are discussed more fully in the sections that follow.

New Skills and Teacher Techniques

Most studies provide evidence that teachers feel they have gained knowledge or increased their skills through teacher enhancement programs. There are fewer studies, however, that provide evidence of increased teacher knowledge using measures other than self-report.

With few exceptions, participants in teacher enhancement programs rated themselves as having increased their knowledge of science and mathematics, and of ways to teach the subjects, as a result of their experiences. For the most part, these data on teacher ratings, collected at the conclusion of the teacher enhancement program, provide short-term assessments. For example, Taagepera, Miller, and Benesi (1985) reported that 88 percent of the 100 teachers in the University of California-Irvine Summer Science Institute agreed that courses were increasing their understanding of basic concepts in science. No evidence beyond that of self-report was provided.

A few studies have included standardized measures of gains in teacher knowledge. Some of these studies, however, are plagued by measurement difficulties. For example, Horak, Blecha, and Enz (1982) found no increase in teacher science knowledge, but they used such an easy test that many teachers scored 100 percent on both the pre- and post-program tests. When measures are adequate, however, standardized tests can show significant increases in teacher knowledge. In one report, Weiss, Boyd, and Hessling (1990) cite a study in which participants improved from a median score at the 62nd percentile on the National Science Teachers Association/American Association of Physics Teachers (NSTA/AAPT) high school physics test to a median score at the 85th percentile during the second summer, to a median at the 99th percentile by the third summer. In another study (Rhoton, Field, and Prather 1992), there were statistically significant gains in teachers' instructional and curricular skills and content mastery as measured by pre- and post-program tests.

In summary, most evaluations report that teachers feel better about their content knowledge and teaching skills as a result of teacher enhancement programs. Increased confidence about their subject matter knowledge can lead to a decrease in anxiety about teaching math and science. Although most of the evaluations are based on teachers' self-report, increased teacher confidence about knowledge and skills has been considered an important contributor to adaptive and effective teacher behaviors in the classroom.

Transfer of Skills to Classroom Practice

Teachers report a number of different ways in which they have applied their lessons to practice. However, there has been limited corroboration of the actual implementation of changes by evaluators.

Marable (1990) reported that teachers indicated that they developed curriculum materials for use in their classrooms. Boser and associates (1988) found that teachers reported a significant increase in time devoted to lab activities in classes as a result of the Science Teachers Research Involvement for Vital Education (STRIVE) program. Webb (1992) reported that over 93 percent of the teachers reported increasing their use of demonstrations, laboratory experiments, or other practical activities. Finally, Hadfield (1992) found in post-inservice questionnaires administered after teachers had returned to their home schools that teachers reported spending more time teaching math, using materials from the workshop, and getting positive responses from students about instruction.

One study (Eash, Hagar, and Weigrecht 1989) did attempt to assess classroom changes using measures other than self-report. The researchers used students as observers of teachers to support their self-reports of changes. Specifically, they found that student reports verified participant teachers' claims of changes in classroom approach in the following activities: requiring students to plan and organize cooperative group projects; including in classroom work applications of science concepts in industry; stressing the importance of science in society; increasing student interest in science as a career; increasing the use of questioning during class; and introducing new materials into the regular curriculum. In another study (Carpenter et al. 1989), classroom observations were included in the evaluation. These observations indicated that even though specific instruction patterns were not prescribed in the teacher enhancement workshop, the teachers who participated in the training activities spent more time in the classroom talking about problems and discussing alternative solutions than did teachers of control classes. These behaviors were not, however, an explicit component of the professional development experience.

Impact on Renewal and Career Satisfaction

Many advocates of teacher inservice mention that teachers see a sense of renewal and increased connection to their field and profession as an important benefit of these programs. Teachers place strong value on the opportunity to share ideas and teaching techniques that these programs provide.

Jarvis and Blank (1989) report that the comment most often made about the program concerned the personal and professional benefits obtained from exchanging and sharing ideas with one another. Taagepera, Miller, and Benesi (1985) indicated that teacher contact with professors in the program was a critical component of the institute's success. This contact resulted in future collaborative efforts, such as a Saturdays for Science program and the NSF-sponsored UCI Science and Math Mentor Teacher Program. Lombard, Konicek, and Schultz (1985) reported that all participants in the Science Teaching and Development of Reasoning workshops indicated that one important value of the workshops was the opportunity to meet together and discuss their experiences and ideas. One program, The Urban Mathematics Collaborative (Heck, Webb, and Martin 1994), is based on the assumption that teacher networking is an inherent part of the collaborative effort because it "reduces teachers' sense of isolation, encourages professional enthusiasm and innovation in teaching, and exposes teachers to new developments and trends in mathematics and instruction." Finally, Armstrong (1987) reported that participants believed that the best aspect of the Leadership Institute was the opportunity for sharing ideas with colleagues.

Teachers frequently report that teacher enhancement experiences influenced their feelings of confidence about teaching math and science and their sense of satisfaction about their career choice. Weir (1988) reported that participants in a month-long summer science institute felt more confident about teaching science to children, and that they subsequently made more time for science in their teaching, "no matter what." Other programs, such as NSF-sponsored programs that took place on college campuses during the summer as well as during the school year (Orton 1980), have reported that an outcome of the program was an increase in participants going on for master's degrees, a sign of renewed motivation and a desire for advancement. Teachers also demonstrate a sense of renewal through taking on new leadership roles as teachers, thereby advancing their careers into positions such as mentor teachers and curriculum specialists.

Impact on Leadership

Another bright spot in teacher enhancement programs has been their effect on teacher leadership and empowerment. In fact, one fundamental goal of these projects has been to develop cadres of teachers who will take the lead in promoting changes in math and science education.

In the San Francisco Math Leadership Project (Armstrong 1987), there was a dramatic increase in teachers' participation in professional associations, and participants saw themselves as emerging as math leaders in their schools. Kroll (1990) reported that workshop participants shared a great deal about their experiences with other teachers in their home schools who had not attended the workshop. Leadership was also evidenced at faculty meetings, with participants acting as recruiters, trainers, and support personnel for the project in the future. Henderson and Brown (1987) reported that the Monterey Bay Area Mathematics Project resulted in an increase in participation in professional development activities. Project participants also conducted inservice sessions for other teachers. Finally, Garner-Gilchrist (1993) stated that Mathematics Institute Program participants conducted workshops in their respective schools following the institute.

The evidence of teacher leadership and empowerment illustrates how teacher enhancement programs can create a ripple effect that reaches beyond the influence on actual participants. Participants themselves became proponents of positive change.

Student Outcomes

In general, evaluations of teacher enhancement programs have rarely produced credible evidence of positive student outcomes, particularly in the area of student achievement. This is because most evaluations have surveyed teachers who can only report their impressions of changes in students' achievement or attitudes. Further, the adequacy of existing measures of achievement in mathematics and science have been strongly questioned, and more acceptable ones are only in the early developmental stages. Nevertheless, a small number of studies have addressed the impact of teacher enhancement programs on students.

One study in particular stands out. Using pre- and post-program test measures of student achievement, Rhoton, Field, and Prother (1992) found statistically significant gains in the performance of students whose teachers had participated in an NSF Science Education Leadership Institute. It should be noted that this project was a long-term intervention and included the participation of the school principal. These two factors made this teacher enhancement program fit into a larger systemic reform effort. Eash, Hagar, and Weingrecht (1989) also used pre- and post-test measures administered to students in classes taught by teachers who had participated in a National Science Foundation teacher enhancement workshop. Results indicated that these students demonstrated improved attitudes toward science education and greater academic achievement when compared to students taught by teachers who had not participated in the workshop.

Another evaluation (Madsen and Lanier 1992) used tests, written work, and verbal comments to measure student outcomes after teachers had participated in an intensive staff development program. The Support Teacher Program included updating teachers' knowledge about current research on teaching and learning mathematics and working with other professionals in a peer support program. At the end of 1 year, student results indicated a more positive attitude towards mathematics, an improved ability to solve problems, and an increased conceptual understanding of mathematics. Finally, Carpenter et al. (1989) reported that students in classes where teachers had received training in "cognitively-guided instruction" performed better on complex addition and subtraction and problem-solving activities than students in control group classes.

However, a multi-year study by Stallings and Krasavage (1987) raises some questions about whether or not such changes may be highly transitory. Stallings and Krasavage reported that professional development based on the Madeline Hunter model led to changes in teacher practices, student engagement, and achievement during the first 2 years of an intensively supported follow-through program. In the third year, when assistance to teachers was removed, both instructional fidelity and student performance declined.

Other than these studies, most evaluations either ignore student achievement or provide unconvincing and often anecdotal teacher reports of positive student outcomes, relying instead on self-report. In one example, Webb (1992) found that 90 percent of teachers reported an increase in students' interest in subject matter content and achievement. A large-scale evaluation of NSF Teacher Enhancement programs (Abt 1993) also found that teachers report significant gains in students' enthusiasm and achievement in science. However, because these findings are based on self-report, they provide unconvincing evidence of real gains in student performance.

Conclusions

Taken together, what do these evaluations tell us about the impact of teacher enhancement programs? The picture is clearly mixed, with evidence that can both give comfort to supporters and fuel the concern of critics. Despite the reliance on self-report, these evaluation findings provide substantial support for the benefits of professional development programs, at least where goals such as new knowledge, renewal, and professional leadership are concerned. The number of studies that report positive impacts in these areas suggest that participation in teacher enhancement programs make teachers feel better about themselves, their profession, and their ability to be effective in their roles.

Results with regard to classroom practice are less solid, but appear to be in the right direction. Teachers report using what they have learned, both in terms of content and process.

Support for the impact of teacher enhancement programs on student outcomes is, however, less convincing, given the evidence that we have been able to locate. Most studies either do not address student outcomes or provide indirect evidence that cannot be rigorously evaluated.[7] This lack of evidence should not be considered surprising, given the difficulty of establishing such linkages and the relatively insignificant amount of funding that has been allocated to most evaluation efforts. What is needed is a well-designed, longitudinal effort that can document changes (or lack of changes) in teacher skills, teacher classroom behaviors, and student attitudes and achievement over time. Such a study must look not only at the contribution of the teacher enhancement experience, but also at how the learning environment—the school and the classroom—is structured to support and reinforce the changes that need to take place. It is unlikely, however, that even the best designed study will show that the teacher enhancement and nothing else has caused any changes that might be found. As we saw in previous chapters, educators today see teacher enhancement as a major component of reform efforts, not as a stand-alone treatment. Studies should be designed to reflect the logic of this model and examine how teacher enhancement contributes to the success of the overall effort.

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[7] It should be pointed out, however, that changing student outcomes has not always been the goal of teacher enhancement programs. Often, they have been designed to change teacher behaviors. Further, very little evaluation has been carried out on programs believed today to represent "best practice" in teaching techniques and teacher behaviors.

Our look at evaluation of teacher enhancement programs clearly indicates that we know far too little about what our investment in such programs is returning. Excuses as to why hard questions cannot be addressed sound increasingly hollow. The picture we find leads us to echo the conclusion of the report of the Expert Panel for Review of Federal Evaluation Programs (1993) regarding federal evaluation in general.

> ***"Current SMET education evaluation practices are often inadequate for the purpose of improving programs, making informed decisions about program retention or expansion, or providing for real accountability."***

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APPENDIX A

TEACHER ENHANCEMENT PROGRAMS

Index of Teacher Enhancement Programs

Examples of Programs—Varied Funding Sources

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Examples of Programs--Varied Funding Sources

1. PROGRAM NAME AND SPONSOR

Teacher Summer Business Training and Employment Program
New York State

2. TYPE OF PROGRAM

Two-month summer program in which teachers were placed in businesses.

3. SCHOOL LEVEL

Elementary, middle, and high school

4. FOCUS

The focus of the program was to place math, science, and occupational education teachers in businesses over the summer to expose them to advances in science and technology and to give businesses competent part-time employees.

5. IMPACTS

A. TEACHER KNOWLEDGE

The program sought to increase teachers' knowledge of science and technology in applied settings.

B. CLASSROOM APPLICATION

It was hoped that teachers would pass on the knowledge they gained to their students.

6. REFERENCE

Guerrero, F., Walker, S., and Marta, J. (1986). *Teacher Summer Business Training and Employment Program 1984-85. Final Report. OEA Evaluation Report.* New York City Board of Education, Office of Educational Assessment, Brooklyn, NY.

1. PROGRAM NAME AND SPONSOR

San Francisco Math Leadership Project
State of California

2. TYPE OF PROGRAM

The program lasts for 1 year and involves a 4-week summer institute, followed by monthly meetings and classroom visits during the school year. Participants in the program also give workshops during the year and go to a mathematics conference. Finally, teachers are recognized by the district for their leadership skills and are given leadership opportunities within the district. Preference is given to selecting pairs of teachers from the same school. Participants from prior years may give presentations at the summer institute.

The project is a collaboration among teachers, principals, school district personnel, universities, and educational agencies.

3. SCHOOL LEVEL

Grades K though 8

4. FOCUS

The program was designed to develop leadership capabilities among K-8 mathematics teachers in San Francisco.

5. IMPACTS

A. TEACHER KNOWLEDGE

One goal of the program was to reeducate teachers, using the ideas from the mathematics reform movement. A focus of the program was to improve teachers' skills in solving mathematical problems.

B. CLASSROOM APPLICATION

Another goal of the program was to increase teacher effectiveness. Participants received classroom visits during the school year.

C. TEACHER NETWORKING

Although networking was not a specific goal of the program, through the leadership goals of having teachers contribute to conferences and inservices, the program does create new opportunities for teachers to interact with others.

D. LEADERSHIP AND EMPOWERMENT

Main goals of the program were to develop teachers' leadership capabilities so that they could share their skills with others and to build the number of math leaders in the Bay Area by having teachers participate in local conferences and contribute their new skills to district inservice programs and to their individuals schools.

E. MINORITY PARTICIPATION

The long-term inservice model was created in order to foster the participation and leadership for women and minorities.

6. REFERENCE

Langbort, C. (1989). Making Math Leaders: The San Francisco Math Leadership Project. 1984-1988. Paper presented at the Annual Meeting of the American Association of Colleges for Teacher Education (Anaheim, CA, March 2-5, 1989). ERIC Document No. 309-027.

1. PROGRAM NAME AND SPONSOR

Comprehensive Instructional Management Systems (CIMS)
New York City Board of Education, Brooklyn, NY

2. TYPE OF PROGRAM

In this program, lead science cluster teachers and school supervisors participated in weekly workshops taught by district and central CIMS science coordinators. District and central CIMS science coordinators also did workshops for teachers, went to classrooms, and had individual meetings with teachers. Cluster teachers, in turn, helped classroom teachers implement instructional activities. School supervisors ensured that the program was being implemented effectively.

Other than a few staff development days that were mandated for all teachers, most teacher training was voluntary and offered after school.

3. SCHOOL LEVEL

Kindergarten through the 4th grade

4. FOCUS

The focus of the program was to help teachers teach the New York State Elementary Science Syllabus by using the Comprehensive Instructional Management Systems science program. The CIMS takes a hands-on inquiry approach to learning and includes process skills and content goals. The CIMS also includes an assessment package with activities and written tests that teachers can use to guide their teaching.

5. IMPACTS

A. TEACHER KNOWLEDGE

The program is designed to increase teacher knowledge of the hands-on inquiry approach.

B. CLASSROOM APPLICATION

The program helps teachers incorporate the approach into their teaching. Teachers are also given a guided study kit with manipulatives that they can use to assess how students do in various activities.

C. LEADERSHIP AND EMPOWERMENT

The cluster teachers were placed in leadership roles by having them train other teachers and create staff development activities and revise curriculum for the district.

6. REFERENCE

New York City Board of Education (1992). *Comprehensive Instructional Management Systems (CIMS)--Science 1991-92. OREA Report.* ERIC Document No. 359-075.

1.	**PROGRAM NAME AND SPONSOR**
	The Enhancement of Science and Mathematics Teaching (EMST) project conducted by the Florida State University The Florida State University
2.	**TYPE OF PROGRAM**
	The project involved a 20-day summer program, 6 days of which were for both teachers and administrators. Two teachers came from each school. Interaction between the university team and the school continued throughout the year.
3.	**SCHOOL LEVEL**
	Elementary, middle school, and high school
4.	**FOCUS**
	Teachers and the university team worked together to identify topics for the workshop. Included in the workshops were topics such as constructivism, integrating math and science, problem solving, classroom research, and mentoring colleagues. As the project expanded into another county, "families of schools" were created that included elementary, middle, and high schools. The purpose of creating families of schools was to allow more collaboration between teachers of different instructional levels.
5.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	One goal of the program was to increase teacher knowledge.
B.	**CLASSROOM APPLICATION**
	Another goal was to transfer the newly gained knowledge and skills to the classroom.
6.	**REFERENCE**
	Tobin, K., Davis, N., Shaw, K., and Jakubowski, E. (1991). Enhancing Science and Mathematics Teaching. *Journal of Science Teacher Education,* 2 (4), 85-89.

Federal Agency Programs

1. PROGRAM NAME AND SPONSOR

University of California at Irvine Summer Science Institute
National Science Foundation

2. TYPE OF PROGRAM

Faculty from the University of California at Irvine (UCI) train science specialists who serve as resource teachers to other teachers and also spend some time teaching students. The program includes a 4-week summer institute during the summer, a 1-day followup activity, and continuing help from the university in curriculum development.

The UCI Science Advisory Board is made up of UCI members and persons from technology-based industry. The Board makes decisions about curriculum design for the program.

3. SCHOOL LEVEL

Elementary, junior high, and high school

4. FOCUS

The focus of the program is to improve science teaching and curricula for children in kindergarten through the 12th grade.

5. IMPACTS

A. TEACHER KNOWLEDGE

One of the goals is to increase teacher knowledge in specific areas.

B. CLASSROOM APPLICATION

Specialists teach students using what they learned in the program and supplement the work done by regular teachers.

C. LEADERSHIP AND EMPOWERMENT

Although leadership training does not appear to be a component of the program, two teachers at each instructional level (elementary, junior high, and high school) participate in steering committees designed to develop a unified science curricula.

6. REFERENCE

Baum, R. (March 11, 1985). California Summer Institute Boosts Science Teacher Effectiveness. *C&EN.*

1. PROGRAM NAME AND SPONSOR

Chemistry Camp Inservice for Middle School teachers, Chicago State University
Eisenhower program

2. TYPE OF PROGRAM

The CHEM CAMP program includes master teachers, inservice teachers, and students. Master teachers participated in the program at an earlier time and are responsible for recruiting teams of teachers from their schools.

The inservice is a 4-week summer program involving content instruction, laboratory practice, and practice teaching of middle school students.

3. SCHOOL LEVEL

Middle school

4. FOCUS

The program was designed to provide training in how to implement a program of hands-on chemistry experiments for students.

5. IMPACTS

A. TEACHER KNOWLEDGE

Goals of the program are to change teachers' attitudes toward science and provide more content in chemistry.

B. CLASSROOM APPLICATION

Another goal of the program was to provide pedagogical strategies to teachers.

C. TEACHER NETWORKING

The program also provides networking opportunities for teachers.

D. LEADERSHIP AND EMPOWERMENT

The program provides leadership experiences for the mentor teachers who teach the other teachers in the program.

E. MINORITY PARTICIPATION

Teachers and students are drawn from schools with high minority concentrations, ensuring equitable opportunity for professional development among teachers.

6. REFERENCE

Frechtling, J., Ruskus, J., Raizen, S., and Scheirer, M. (1994). *Teacher Enhancement/Development Study: A Look at Best Practice, Phase 1.* Interim Report. National Science Foundation, Division of Research, Evaluation and Dissemination.

1. PROGRAM NAME AND SPONSOR

Marine Science Teacher Education Program (MSTEP)
National Science Foundation

2. TYPE OF PROGRAM

The program is a National Science Foundation Teacher Enhancement (TE) program designed for teachers in the Los Angeles Unified School District through the collaboration of scientists, science teachers, a former district science teacher, and graduate students. The district is also a partner in the program. Teachers who graduate from the program may return to subsequent summer workshops as presenters.

The MSTEP program includes a 6-week summer workshop and six 1-day followup sessions. The program has a final followup session that is district-wide and is developed and implemented by participants.

3. SCHOOL LEVEL

Grades 5 through 12

4. FOCUS

Teachers in the program are involved in field work at the Wrigley Marine Science Center on Catalina Island, are presented marine science curricula, and develop an implementation plan for their science unit to be taught in the upcoming school year.

MSTEP incorporates concepts contained in the California Science Curriculum framework. Overall program goals are (1) to encourage the implementation of an integrated science curriculum focused on marine science in a large, city school district, and (2) to excite participants about science and have them bring this excitement back to their schools. The MSTEP program promotes a conceptual or thematic approach to science, involves teachers and students in hands-on learning, and emphasizes inquiry directed by students and active science investigation.

5. IMPACTS

A. TEACHER KNOWLEDGE

In the MSTEP program, participants receive thorough exposure to marine science and pedagogical knowledge and are exposed to nationally disseminated curriculum materials.

B. CLASSROOM APPLICATION

The program encourages classroom application in two ways. First, teachers create and teach at least one thematic science unit based on marine science during the program. Second, teachers develop an implementation plan for their science unit to be taught during the school year.

C. TEACHER NETWORKING

Although it is not stated as a goal, teachers are provided some networking opportunities.

D. LEADERSHIP AND EMPOWERMENT

After the program, teachers are expected to act as instructional leaders in their schools and throughout the district to promote thematic instruction.

E. MINORITY PARTICIPATION

There is some minority participation.

6.	**REFERENCE**
	Frechtling, J., Ruskus, J., Raizen, S., and Scheirer, M. (1994). *Teacher Enhancement/Development Study: A Look at Best Practice, Phase 1.* Interim Report. National Science Foundation, Division of Research, Evaluation and Dissemination.

1. PROGRAM NAME AND SPONSOR

NASA Educational Workshops for Elementary School Teachers (NEWEST) at NASA Langley

The program is funded by both NASA and the National Science Teachers Association (NSTA).

2. TYPE OF PROGRAM

The NASA Langley program is a 2-week summer training program. Although there is little followup after the program, teachers can get ongoing support if they request it.

3. SCHOOL LEVEL

Elementary

4. FOCUS

The program is designed to help elementary teachers learn about aerospace content and give teachers activities and supplies to teach this content in elementary school. Teachers learn through presentations and hands-on activities and do many activities in cooperative teams. What the teachers learn, the facilities, and materials are all related to the aeronautical and atmospheric areas of research at NASA Langley.

5. IMPACTS

A. TEACHER KNOWLEDGE

The program was designed to increase teacher knowledge of aerospace content.

B. CLASSROOM APPLICATION

The program also gives teachers activities and materials to use in teaching aerospace content to children.

C. TEACHER NETWORKING

The program encourages networking and participation in the NSTA.

D. LEADERSHIP AND EMPOWERMENT

Teachers are not given specific training in leadership, but it is hoped that teachers in NASA programs will inform and help their colleagues use what they have learned.

E. STUDENT OUTCOMES AND ACHIEVEMENT

Student achievement is an underlying goal of all NASA programs and is seen as an indirect effect of improving teachers' knowledge and teaching skills.

F. MINORITY PARTICIPATION

Minority participation is also a goal of all NASA programs.

6. REFERENCE

Frechtling, J., Ruskus, J., Raizen, S., and Scheirer, M. (1994). *Teacher Enhancement/Development Study: A Look at Best Practice, Phase 1.* Interim Report. National Science Foundation, Division of Research, Evaluation and Dissemination.

1. PROGRAM NAME AND SPONSOR

Teacher Research Associates Program (TRAC) at Los Alamos National Laboratory (LANL)
Department of Energy

2. TYPE OF PROGRAM

Teachers in the program participated in an 8-week research experience at the LANL. Teachers were matched with mentors based on the mentor's project and field and the teacher's interests.

3. SCHOOL LEVEL

Grades 7 through 12

4. FOCUS

The national goals of TRAC are to give outstanding 7th through 12th grade science, mathematics, and technology teachers a professional scientific or engineering experience through summer research; to build on teachers' leadership skills; to increase teachers' awareness and understanding of current science and technology; to help teachers apply this knowledge to the classroom; and to offer teachers the chance for renewal and professional recognition.

5. IMPACTS

A. TEACHER KNOWLEDGE

The program was designed to increase teacher knowledge through work with mentors. Teachers worked on projects with mentors that included all parts of the research process from collecting data and doing hands-on experiments to analyzing data and writing papers. They learned about new technologies through a variety of means, including direct study, research, and hands-on experience.

B. CLASSROOM APPLICATION

A goal of TRAC is to promote the transfer of knowledge gained in the program to the classroom.

C. TEACHER NETWORKING

Teachers were encouraged to network through computers that they took from the program, but networking was not an actual program goal.

D. LEADERSHIP AND EMPOWERMENT

Enhancing teacher leadership is a goal of the TRAC program.

E. MINORITY PARTICIPATION

Minority participation was a concern of the program and is a goal of the DOE.

6. REFERENCE

Frechtling, J., Ruskus, J., Raizen, S., and Scheirer, M. (1994). *Teacher Enhancement/Development Study: A Look at Best Practice, Phase 1.* Interim Report. National Science Foundation, Division of Research, Evaluation and Dissemination.

1. PROGRAM NAME AND SPONSOR

Primary Mathematics Education Program (PMEEP)
National Science Foundation

2. TYPE OF PROGRAM

PMEEP is a National Science Foundation Teacher Enhancement project that is a collaboration between Kent State University and 11 school districts in a mostly rural midwestern county. Teachers participate in workshops, keeping journals, peer coaching, visits from county consultants or professors, and 10 days of summer curriculum development.

3. SCHOOL LEVEL

Kindergarten through grade 2

4. FOCUS

The program is based on the NCTM Curriculum and Evaluation Standards for School Mathematics. It is based on a constructivist approach to teaching mathematics and emphasizes problem solving, reasoning, communication, and connections. The program is designed to get teachers to change their curriculum and language and to adopt a more "child centered" worldview.

5. IMPACTS

A. TEACHER KNOWLEDGE

The program increases teacher knowledge of the constructivist approach and the NCTM standards.

B. CLASSROOM APPLICATION

The program is designed to have teachers incorporate constructivism into their curriculum and teaching.

C. TEACHER NETWORKING

The county tries to encourage networking through a teacher newsletter.

6. REFERENCE

Kwartler, T.J. (1993). *PMEEP: Does it Creep into the Worldview of Participants? Microethnography Inquiry into Progress.* ERIC Document No. 356-972.

1.	**PROGRAM NAME AND SPONSOR**
	Middle Grades Mathematics Project (MGMP) National Science Foundation
2.	**TYPE OF PROGRAM**
	Twelve teachers were involved in the program for at least 1 year. Four teachers were uncoached, four were coached, and four were coached and expected to be leaders within their schools. The project worked with lead teachers for 2 years.
3.	**SCHOOL LEVEL**
	Middle school
4.	**FOCUS**
	Since 1977, the project has had the goals of producing curriculum for middle schoolers, assessing the usefulness of the curriculum in the classroom, and understanding what is needed to help teachers teach the curriculum effectively. In the MGMP there is a particular emphasis on having students gain a deep understanding of mathematical concepts. Rather than focusing on memorization and drills, the project strives to have students learn how mathematics is created, why, and how it can be applied. The focus of the current project is to learn how effective coaching is in getting teachers to change their from a computational to a conceptual orientation.
5.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	The program increases teacher knowledge through the MGMP teacher guides provided in the program and through coaching in how to use these guides. The MGMP teacher guides incorporate knowledge needed by teachers in three areas: content, students, and activities. In terms of content, the guides give teachers the background they need to understand the purpose of the mathematical content for each activity and for the whole unit. In terms of student knowledge, the guide gives teachers information about common student misconceptions and methods for correcting them.
B.	**CLASSROOM APPLICATION**
	Coaching in the classroom is used to help teachers implement the program.
C.	**LEADERSHIP AND EMPOWERMENT**
	Lead teachers were developed over 2 years. These teachers were to work with at least one other teacher at their school.
6.	**REFERENCE**
	Lappan et al. (1988). *The Middle Grades Mathematics Project-- The Challenge: Good Mathematics Taught Well.* Final Report to the National Science Foundation.

1.	**PROGRAM NAME AND SPONSOR**
	Project ARCHIMEDES (Applications, Reasoning, and Concepts for High School Instructors: Making Educational Discoveries and Expanding Skills) National Science Foundation
2.	**TYPE OF PROGRAM**
	The program had a wide range of continuing activities, starting with a summer institute to teach physical science concepts, a followup during the school year, courses on physics content and problem-solving skills at the University of North Carolina at Greensboro, and a summer institute on teaching skills.
3.	**SCHOOL LEVEL**
	Secondary
4.	**FOCUS**
	The ARCHIMEDES project was designed with local teachers to increase understanding of concepts among teachers of physics and physical sciences, to inform teachers about students' misconceptions of physics, to provide teaching methods to address misconceptions and enhance students' problem-solving skills.
5.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	The summer institute used hands-on materials to help teachers increase their knowledge of science concepts. In the followup course, teachers also learned about recent developments in physics and research on student misconceptions. Problem-solving courses at the University of North Carolina also gave teachers more background in science and in research to enhance students' problem-solving skills. Finally, the second summer institute focused on electronics, electric laboratory equipment, and how to use computers in the classroom.
B.	**CLASSROOM APPLICATION**
	In the summer institute, hands-on learning was used to enhance teaching methods to correct student misconceptions. Also, the followup course was designed to help teachers apply what they had learned in the institute to their classrooms.
6.	**REFERENCE**
	Lea, S. (1989). *Project ARCHIMEDES: Applications, Reasoning, and Concepts for High School Instructors: Making Educational Discoveries and Expanding Skills.* ERIC Document No. 316-107.

1. PROGRAM NAME AND SPONSOR

Honors Workshop for Middle School Science Teachers
National Science Foundation

2. TYPE OF PROGRAM

This program was designed for middle school science teacher leaders, who had some input into the planning of the program. The program involved a 4-week summer workshop in addition to six Saturday workshops over 2 school years.

3. SCHOOL LEVEL

Middle school

4. FOCUS

The goals of the project were to help teachers improve their conceptual understanding of fundamental scientific principles, learn about student misconceptions, learn how to create assessments of whether students understand basic concepts, and increase their knowledge of scientific method.

5. IMPACTS

A. TEACHER KNOWLEDGE

The program sought to increase teachers' knowledge of basic scientific principles, student misconceptions, assessment, and scientific method. In order to increase teachers' knowledge of basic scientific method, teachers received instruction in observation, measurement, and experimentation.

B. CLASSROOM APPLICATION

The program stressed hands-on learning and giving students skills in measurements and observation. The program worked with participants over a 2-year period to help teachers with this approach.

C. TEACHER NETWORKING

The program started a computer teleconferencing system that allows teachers to contact other teachers in their school system and other school systems on a daily basis. Two teachers in each area (physics, earth science, chemistry, and biology) are assigned responsibilities for communicating on the network. In each area, one teacher served as the content coordinator and another served as a moderator. The principal investigators at the University of North Carolina at Greensboro, who operate the teacher enhancement project, are also involved in the network, as are their graduate students.

D. LEADERSHIP AND EMPOWERMENT

Teachers were originally chosen for the program because of their leadership ability and teaching expertise. As teacher leaders, they were already well suited to teach other teachers. Teachers in the program were required to give at least two workshops to other educators in their school system about what they learned in the program.

6. REFERENCE

Meisner, G., and Lee, E. (1988). *Honors Workshop for Middle School Science Teachers*. ERIC Document No. 316 144.

1. PROGRAM NAME AND SPONSOR

Columbia College Summer Science Workshops, Networks for Teaching Science
National Science Foundation

2. TYPE OF PROGRAM

The program involved a 4-week summer workshop for teachers.

3. SCHOOL LEVEL

Middle school

4. FOCUS

The workshop curriculum emphasized the relationship between basic middle school concepts and environmental issues and included many hands-on activities for teachers.

5. IMPACTS

A. TEACHER KNOWLEDGE

Increasing teacher knowledge was a major goal of the program.

B. CLASSROOM APPLICATION

Another program goal was to improve instructional skills of middle school science teachers.

C. STUDENT OUTCOMES AND ACHIEVEMENT

Another goal of the workshops was to improve student achievement scores in science.

D. MINORITY PARTICIPATION

Teachers who taught in lower income and disadvantaged communities in the Chicago area were especially encouraged to participate.

6. REFERENCE

Miller, J. (1994). *Enriching Middle School Science: A Final Evaluation of the 1991-92 Columbia College Workshops Utilizing an Innovative Approach to the Teaching of Science.* Chicago Academy of Sciences Report.

1. PROGRAM NAME AND SPONSOR

Post-Graduate Life Science Institute for Secondary Science Teachers, Baylor College of Medicine
Fund for the Improvement of Postsecondary Education (ED), Washington, DC

2. TYPE OF PROGRAM

This was a 3-year program in which teachers participated in a variety of instructional activities related to life sciences. Each year, teachers in the Houston area participated in five half-day workshops, one 6-week summer institute, and enrichment activities during the school year.

The content of the program was decided by a Content Review Committee that was composed of faculty from the Baylor College of Medicine, the University of Houston, and the Houston Independent School District. Teachers who participated in the program also had input into planning program activities.

3. SCHOOL LEVEL

Grades 7 through 12

4. FOCUS

To enhance the quality and increase the science knowledge of high school life science teachers.

5. IMPACTS

A. TEACHER KNOWLEDGE

The program emphasized increasing teacher knowledge in the life sciences. Teachers covered the content areas of cell biology, anatomy/physiology, microbiology, and biochemistry. During the summer institutes, teachers spent much time in laboratory settings doing hands-on activities and gaining exposure to science process skills.

B. CLASSROOM APPLICATION

The program was designed to support teachers in their teaching activities. The workshops provided new curriculum materials to teachers and stressed hands-on activities.

C. TEACHER NETWORKING

The program created and maintained a science teacher network through the ongoing activities of the program.

D. LEADERSHIP AND EMPOWERMENT

Teachers who completed the program the first year were involved in the enrichment activities of teachers who joined the program in the second and third years. Teachers who participated in the program also served as resources in their schools.

6. REFERENCE

Roush, R., Thomson, W., and Miller, L. (1988). *Post-Graduate Life Science Institute for Secondary School Teachers. Executive Summary*. ERIC Document No. 299 137.

Programs of Private Business and Industry

1. PROGRAM NAME AND SPONSOR

Business-Education Compact Educator Excellence Programs-- Internships

The program is funded by businesses, school systems, and an educational consortium.

2. TYPE OF PROGRAM

The Internships program is a national site for Industry Initiatives for Science and Math Education (IISME). Educators are placed in paid positions in businesses over the summer. Educators also receive graduate credit when they complete activities in an Action Plan describing how the business experience will be applied to the classroom.

Some teachers participate in the program individually, while others participate in teams.

Most internships last from 3 to 8 weeks. There are also followup activities throughout the year.

3. SCHOOL LEVEL

Elementary, middle, and secondary

4. FOCUS

The focus of the internships is to provide educators with new knowledge, ideas, and methods for improving their classroom teaching and/or management skills. Educators also become a direct connection between the school and the workplace site.

5. IMPACTS

A. TEACHER KNOWLEDGE

The program is designed to inform educators about careers in industry and their requirements; make educators aware of real world applications in a subject area; inform educators about how businesses are run and organized; and increase knowledge in subject areas related to the business in which they intern. The program is also designed to give educators more skills and greater confidence.

B. CLASSROOM APPLICATION

Another goal of the program is to create better and more relevant teaching in the classroom. Educators who participate in the program are encouraged to write Action Plans that describe how they will use their summer business experience in the classroom.

C. TEACHER NETWORKING

Teachers have access to an electronic bulletin board, IISMENet. Through IISMENet, teachers can communicate with each other and share their Action Plans with others.

D. STUDENT OUTCOMES AND ACHIEVEMENT

Because of the program, students are expected to be more in touch with business through the relationship between the educator and the business mentor. Through the educator's business experience and the new curricula that may result from it, students are also expected to be better prepared to go into and be effective in work sites that employ complex technology.

E. MINORITY PARTICIPATION

In order to achieve diversity, the program is used in a variety of schools, including inner-city magnet schools, rural schools, and alternative schools.

6. REFERENCE

Personal communication and materials received in 1995 from:

Pat Moore
Director of Services
Business Education Compact
P.O. Box 500, 74-250
Beaverton, Oregon 97077

1. PROGRAM NAME AND SPONSOR

Business-Education Compact Educator Excellence Programs-- Educator Internships for Research and Curriculum Development

The program is funded by businesses, school systems, and an educational consortium.

2. TYPE OF PROGRAM

Integrated teams of educators (e.g., including administrators, counselors, and interdisciplinary teachers) visit business sites to get information about skills needed in the workplace and how they are applied. This information is used to create curriculum for the schools.

These programs start with 8 days or more at different industry sites. Experiences at job sites may include tours, job shadowing, and meetings. The educators and the businesses decide on the format and objectives of the internships.

3. SCHOOL LEVEL

Elementary, middle, and secondary

4. FOCUS

The goals of the program are for educators to (1) collect information about what skills are needed for jobs in a particular industry; (2) identify how these skills are used; (3) create teaching materials based on the real world applications seen in the businesses visited; and (3) find possible work-based learning opportunities for students and make connections to curriculum goals that prepare students for work.

5. IMPACTS

A. TEACHER KNOWLEDGE

The program increases educators' knowledge of work place skills and applications.

B. CLASSROOM APPLICATION

One of the goals of the program is for the teams to produce curriculum and classroom activities that help students understand real world applications of skills taught in the classroom.

C. TEACHER NETWORKING

Educators have access to an electronic bulletin board, IISMENet.

D. STUDENT OUTCOMES AND ACHIEVEMENT

An underlying goal of the program is to improve student learning through improved curriculum and activities.

E. MINORITY PARTICIPATION

Although diversity is not ensured directly, programs are open to all educators in the Oregon area. Also, there are some special projects conducted in areas with high concentrations of economically disadvantaged persons and persons from ethnic minorities.

6. REFERENCE

Personal communication and materials received in 1995 from:

Pat Moore
Director of Services
Business Education Compact
P.O. Box 500, 74-250
Beaverton, Oregon 97077

1. PROGRAM NAME AND SPONSOR

Business-Education Compact Educator Excellence Programs-- Visitations

The program is funded by an educational consortium.

2. TYPE OF PROGRAM

Visitations are short-term, 2-day programs in which educators visit four different work sites. During the visits, educators may take tours, do job shadowing, do interviews and/or other activities. Following the program, educators report their activities.

3. SCHOOL LEVEL

Elementary, middle, and secondary

4. FOCUS

The goals of the program are to (1) increase educators' awareness of the number of different jobs at a single business site and their requirements and (2) create a partnership between industry and education. Through the program, it is hoped that educators will create new curriculum, use teaching strategies based on business applications, and promote work-based learning.

5. IMPACTS

A. TEACHER KNOWLEDGE

The program is designed to increase educators' knowledge of industry jobs and requirements.

B. CLASSROOM APPLICATION

It is hoped that the visitations will result in new curriculum and teaching strategies.

C. MINORITY PARTICIPATION

The program is open to all teachers in the Oregon area. There are also some special programs in areas with many ethnic minorities and economically disadvantaged persons.

6. REFERENCE

Personal communication and materials received in 1995 from:

Pat Moore
Director of Services
Business Education Compact
P.O. Box 500, 74-250
Beaverton, Oregon 97077

1. PROGRAM NAME AND SPONSOR

Elementary Inquiry Science Institute
Jointly funded by the Exploratorium (San Francisco's museum of science, art, and human perception), the U.S. Department of Education, the National Science Foundation, and Hewlett-Packard

2. TYPE OF PROGRAM

The program is open to districts participating in Hewlett-Packard's K-6 Hands-On Science Program that have participated in the National Science Resources Center (NSRC) Leadership Institute and that have started to use hands-on curriculum. The program is aimed at teachers who have leadership experience.

The program is a 2-week institute at the Exploratorium for six teams of four members each (three lead teachers, one administrator).

3. SCHOOL LEVEL

Kindergarten through the 6th grade

4. FOCUS

To promote inquiry-based science instruction by developing a group of leaders who will foster the development of inquiry approaches to teaching in schools and districts.

5. IMPACTS

A. TEACHER KNOWLEDGE

Two objectives of the program are to help teachers understand the nature of science inquiry and build on their skills as inquirers.

B. CLASSROOM APPLICATION

The program is designed for teachers to use inquiry approaches in the classroom rather than using hands-on activities in a mechanical way. Participants also learn new methods and tools to support inquiry-oriented approaches in the classroom. Teaching strategies that are practiced and modeled in the program include cooperative group work and group brainstorming.

C. TEACHER NETWORKING

Participants may become part of a national network of educators who use inquiry-oriented approaches.

D. LEADERSHIP AND EMPOWERMENT

The program is designed to further enhance leadership in professional development. A series of seminars is devoted to helping the teams of educators teach the inquiry method to colleagues and to helping the teams design inquiry-based professional development programs in their district.

6. REFERENCE

Elementary Inquiry Science Institute (1995). Call for proposals. Hewlett-Packard Company.

1.	**PROGRAM NAME AND SPONSOR**
	The K-3 Mathematics Education Program The Exxon Educational Foundation
2.	**TYPE OF PROGRAM**
	K-3 Mathematics Specialists grants are given to schools. The National Council of Teachers of Mathematics (NCTM) coordinates how the program is implemented in each school. The ways that each school uses the funding from Exxon varies, but most schools use the funds for teachers' and specialists' professional development and for buying materials and teaching aids. Schools form partnerships not only with the NCTM, but also with other professional organizations, universities, and often other education groups.
3.	**SCHOOL LEVEL**
	Kindergarten through the third grade
4.	**FOCUS**
	The program is based on the NCTM Professional Standards and on training math specialists who, in turn, train other teachers and work with children. Specialists also promote quality math teaching in the school and many conduct programs for parents and students.
5.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	One of the goals of the program is to increase teacher knowledge. Among other topics, teachers learn how to use numerical information and computers.
B.	**CLASSROOM APPLICATION**
	Teachers learn new teaching techniques and how to involve students in group work.
C.	**TEACHER NETWORKING**
	The NCTM serves to facilitate a network of K-3 projects and teachers.
D.	**LEADERSHIP AND EMPOWERMENT**
	This is a program in which teachers train other teachers; thus, leadership is an important component.
E.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	Improving student outcomes is a goal of the program.
6.	**REFERENCE**
	Exxon Education Foundation: Mathematics Education Program (1994) Document above provided by: Exxon Education Foundation 225 E. John W. Carpenter Freeway Irving, TX 75062-2298

1. PROGRAM NAME AND SPONSOR

The Georgia Industrial Fellowships for Teachers (GIFT)
Mixed funding, including corporate sponsorships, foundation grants, the Eisenhower Program, Title II, Higher Education, the National Science Foundation, and the Howard Hughes Medical Institute.

2. TYPE OF PROGRAM

GIFT includes paid summer work or research and internship opportunities in addition to workshops during the summer and school year. GIFT programs involve a variety of research experiences in addition to the GIFT-corporate program that involves 7- or 8-week work experiences in Georgia businesses and industries. There is also a special program, MINI-GIFT, for middle grades teachers that involves work or research and the development of education materials in informal science education settings.

Recently, GIFT has expanded to include more teacher and administrative involvement in planning activities. The program now includes teachers and administrators in GIFT planning and implementation and involves teachers in GIFT activities and those of the Georgia Institute of Technology's Center for Education Integrating Science, Mathematics and Computing (CEISMC).

3. SCHOOL LEVEL

Elementary and middle school

4. FOCUS

The goal of GIFT is to achieve better precollege teaching and learning using a systemic approach that focuses on the job of teachers in preparing students as workers and informed citizens. The program is designed for teachers to gain firsthand experience with new technologies and research, applied science, mathematics, and computing; to strengthen ties between education and industry; and to have teachers also gain experience in teamwork and collaborating with others and have the opportunity to see how inquiry, problem-solving, and reasoning are applied in the "real world."

5. IMPACTS

A. TEACHER KNOWLEDGE

Both GIFT and MINI-GIFT programs have the goal of increasing teacher knowledge.

B. CLASSROOM APPLICATION

The programs also have the goal of classroom application. Teachers are asked to write an Action Plan for how they will use what they have learned in the program in their classroom.

C. TEACHER NETWORKING

Teachers are able to share their experiences with others through a professional network called the GIFT Academy.

D. LEADERSHIP AND EMPOWERMENT

E. STUDENT OUTCOMES AND ACHIEVEMENT

GIFT was developed because of declining student achievement in mathematics and science. One of its goals is to improve learning and prepare students for the future.

6. REFERENCE

GIFT and Project GIFT: History and Overview, 1991-1994 (1995)

Annual Report (GIFT). (March 31, 1995). Center for Education and Integrating Science, Mathematics and Computing, Georgia Institute of Technology.

Materials sent in 1995 by:

Joanna H. Fox
Georgia Institute of Technology
The Center for Education Integrating Science, Mathematics and Computing (CEISMC)
Atlanta, GA 30332-0282

1. PROGRAM NAME AND SPONSOR

Industry Initiatives for Science and Math Education (IISME)
Mixed funding from corporate, private, and government foundations

2. TYPE OF PROGRAM

A variety of programs are offered to teachers through IISME, such as the Summer Fellowship Program, the IISME Academy, IISME VISION, and several others. The core program of IISME is the Summer Fellowship Program, provided to middle and high school teachers. These fellowships allow teachers to work for 8 weeks in industries, government agencies, and university research laboratories. The IISME program also has services during the school year through the IISME Academy.

3. SCHOOL LEVEL

Elementary, middle, and secondary

4. FOCUS

The goal of IISME is to improve mathematics and science education in the San Francisco Bay Area. The core program, the Summer Fellowship Program, is designed to help teachers bring science and technology to their classrooms, explain their importance to students, be knowledgeable about science and technology professions, and interest their students in innovative ways.

5. IMPACTS

A. TEACHER KNOWLEDGE

The IISME program weeks to provide teachers new knowledge and an improved attitude through challenging work assignments.

B. CLASSROOM APPLICATION

Teachers in the summer program are asked to write an action plan that describes how they plan to use their industry experiences and newly gained knowledge in the classroom.

C. TEACHER NETWORKING

Teachers are divided into community groups at or near their company placements. These groups provide support and community for participating teachers and allow for networking opportunities. IISME also has a newsletter that provides a mechanism for participants to communicate their experiences.

In addition, the IISME Academy provides support and networking opportunities to teachers through workshops throughout the year that inform teachers about industry ideas and how to include them in their teaching. Teacher fellows and mentors from the Summer Fellowship Program are part of the Academy and may participate in all academy activities. There is also a computer network, IISMENet, that links alumni with each other and the education community.

D. STUDENT OUTCOMES AND ACHIEVEMENT

It is hoped that teachers in IISME will motivate students to become scientifically literate and enter technical careers.

11. REFERENCE

Industry Initiatives for Science and Math Education: Shaping the Future (1995). Unpublihed program description, University of California-Berkeley, Lawrence Hall of Science. Partners in Education: The IISME Experience 1991-1994 Addendum.

Brochure and description above sent in 1995 by:

Industry Initiatives for Science and Math Education (IISME)
Lawrence Hall of Science
University of California
Berkeley, CA 94720

1. PROGRAM NAME AND SPONSOR

The University of Pennsylvania-Merck Collaborative for the Enhancement of Science Education

The Merck Institute for Science Education, the University of Pennsylvania, and the National Science Foundation

2. TYPE OF PROGRAM

This is a 5-year program in a Philadelphia school district that includes a summer teacher training program, a school year followup program, another training program for teachers, and ongoing partnerships with Merck employees. Partnerships are organized by the University of Pennsylvania. One or more Merck employees is assigned to each school, with teams of employees assigned to most schools. Merck scientists go to schools once a month to provide general assistance and some do hands-on activities with students. Most partnerships are with individual teachers; however, some are with groups of teachers or educators.

3. SCHOOL LEVEL

Elementary

4. FOCUS

The purpose of the program is to improve the way that science is taught at the elementary school level by creating a group of lead teachers who will act as mentors and change agents, incorporate science into language arts, and increase interest in mathematics and science as an area of study and as a career among students who have been historically underrepresented in these fields.

5. IMPACTS

A. TEACHER KNOWLEDGE

In the training workshops, teachers learn about hands-on science theory and receive training in how to use hands-on curriculum kits. They receive this training from Merck employees and professors at the University of Pennsylvania.

B. CLASSROOM APPLICATION

A major goal of the program is to promote hands-on science learning. Visits from Merck mentors once a month and followup activities work to ensure classroom application.

C. TEACHER NETWORKING

Through the institutes and followup activities, teachers network with teachers from other schools, University of Pennsylvania professors, and Merck employees.

D. LEADERSHIP AND EMPOWERMENT

Teachers chosen for the program are selected because they are lead teachers. Teachers are expected to share their experiences and knowledge gained in the program with their colleagues. Because this is the main focus of the program, there is not much additional time devoted to leadership training, per se.

E. STUDENT OUTCOMES AND ACHIEVEMENT

A goal of the program is to increase interest in mathematics and science as a field of study and as a career choice.

F. MINORITY PARTICIPATION

The school district in which the program is conducted was targeted because of the high number of minority teachers and students.

6. REFERENCE

Merck Institute for Science Education. Personal communication and brochure received in 1995 from:

Carlo Parravano, Director, and Michele A. Kloda, Science Specialist
Merck Institute for Science Education
P.O. Box 2000
Rahway, NJ 07065

1. PROGRAM NAME AND SPONSOR

QUEST
The Merck Institute for Science Education and the Dwight D. Eisenhower Mathematics and Science Education Grant Program

2. TYPE OF PROGRAM

QUEST is a 3-week summer program at Princeton University. Teachers participate either individually or in teams. Preference is given to accepting teams of two or three teachers from the same school. There are followup activities during the school year. Also, teachers are encouraged to come back to the program for three more summer sessions.

3. SCHOOL LEVEL

Grades 3 through 6

4. FOCUS

The focus of the program is to help teachers use hands-on learning curricula in their mathematics and science teaching and to facilitate teacher networks in participating schools.

5. IMPACTS

A. TEACHER KNOWLEDGE

One of the goals is to increase teachers' knowledge about science. There are three modules offered in the workshop: geo/life sciences; physical science; and environmental studies/chemistry.

B. CLASSROOM APPLICATION

Teachers learn how to use hands-on curricula, are given specific ideas and activities to use in the classroom, and receive a kit of teaching materials for their classroom.

C. TEACHER NETWORKING

Teachers gain contacts with university faculty and with other teachers.

D. STUDENT OUTCOMES AND ACHIEVEMENT

An underlying goal of the program is to improve student outcomes through improving teaching.

E. MINORITY PARTICIPATION

A wide range of schools is included, from inner-city to suburban. There is a high rate of minority participation.

6. REFERENCE

QUEST (1994) program announcement to teachers

Merck Institute for Science Education. Personal communication and brochure received in 1995 from:

Carlo Parravano, Director, and Michele A. Kloda, Science Specialist
Merck Institute for Science Education
P.O. Box 2000
Rahway, NJ 07065

1. PROGRAM NAME AND SPONSOR

Partnering Institute
Science and Mathematics Network of Central Ohio (network supporters include Battelle, Bischoff and Associates, the Columbus Foundation, the Franklin County Educational Council, and the Ohio Department of Education)

2. TYPE OF PROGRAM

The Institute is a 2-day program for teams of elementary school educators and business persons to develop or build on an existing collaborative partnership. Business partners are those who work in businesses that focus on mathematics, science, or technology. Partnerships vary in structure and configuration. In some partnerships, educators and business persons create goals for teaching together. In these partnerships, business partners are usually in the classroom once a month or more. In other partnerships, business persons are less involved in planning classroom goals and activities.

Some partnerships involve one teacher and one business partner; however, others involve teams of educators (including principals, resource teachers, etc.) and business partners or an entire school.

Several months after the Partnering Institute, there is a followup session to discuss progress and share ideas. During the first year, an experienced Network partner also works with each new partnership.

3. SCHOOL LEVEL

Elementary

4. FOCUS

The mission of the Science and Mathematics Network of Central Ohio is to reform mathematics and science education in Central Ohio elementary schools by creating and supporting education-business partnerships. The focus of the Partnering Institutes is for partners to learn how to create successful reform-focused partnerships and plan activities together for the next school year.

5. IMPACTS

A. TEACHER KNOWLEDGE

The Institute and partnerships increase educators' knowledge about reform-focused partnerships and expose educators to applications of mathematics, science, and technology in business.

B. CLASSROOM APPLICATION

Teachers write a plan for partnership activities and, in some partnerships, teachers and business partners plan and do hands-on activities in the classroom together.

C. TEACHER NETWORKING

Through the partnerships and the Science and Mathematics Network, educators make contacts with business persons and others in the Network.

D. LEADERSHIP AND EMPOWERMENT

Although it is not part of all of the institutes, in one institute teachers and partners took leadership roles by working with new teachers and business persons to help them with their partnerships.

E. STUDENT OUTCOMES AND ACHIEVEMENT

The Partnering Institutes are designed to provide instructional strategies that will excite students about science and mathematics.

F. MINORITY PARTICIPATION

One Partnering Institute was targeted toward African-American teachers and students. Another institute focused on gender equity and was targeted toward women.

6. REFERENCE

Science and Mathematics Network of Central Ohio. Personal communication and materials received in 1995 from:

Barb Sills
Director, Community Relations
Battelle
505 King Avenue
Columbus, Ohio 43201-2693

Pat Barron
Program Manager
Science and Mathematics Network of Central Ohio
445 King Avenue
Columbus, Ohio 43201

1. PROGRAM NAME AND SPONSOR

K-6 Math Teacher Leaders
Science and Mathematics Network of Central Ohio (network supporters include Battelle, Bischoff and Associates, the Columbus Foundation, the Franklin County Educational Council, and the Ohio Department of Education)

2. TYPE OF PROGRAM

This program is a 1-week summer program, followed by 2-day followup sessions during the school year. The program is given to 12 counties in Ohio. All program activities are conducted in groups of 4 counties, rather than in all 12 together, due to the large number of teachers served in the program.

3. SCHOOL LEVEL

Kindergarten through the 6th grade

4. FOCUS

The focus of the program is to develop a group of lead teachers and familiarize them with the state math model and the NCTM standards.

5. IMPACTS

A. TEACHER KNOWLEDGE

A goal of the program is to increase teacher knowledge in content by using mathematics manipulatives.

B. CLASSROOM APPLICATION

Teacher leaders are to apply what they learned in the program by helping other teachers apply the new knowledge in the classroom. Program participants are asked to conduct at least one professional development activity in their district.

C. TEACHER NETWORKING

Some counties in the program have county-wide newsletters. Also, all 12 counties in the program are provided a voice mail system in which phone calls go to a central computer. Through voice mail, teachers exchange teaching ideas, share experiences, and announce inservice opportunities.

D. LEADERSHIP AND EMPOWERMENT

The purpose of the program is to develop and use the skills of teacher leaders.

E. STUDENT OUTCOMES AND ACHIEVEMENT

An indirect goal of the program is to improve student achievement through better quality mathematics instruction.

F. MINORITY PARTICIPATION

Although overall minority participation is low, some of the schools in the program have a large minority population.

6. REFERENCE

Program materials and personal communication received in 1995 from:

Pat Barron
Program Manager
Science and Mathematics Network of Central Ohio
445 King Avenue
Columbus, Ohio 43201

Programs of Foundations

1. PROGRAM NAME AND SPONSOR

Implementation Program
The National Energy Foundation (NEF)

2. TYPE OF PROGRAM

Teachers of all disciplines study issues related to energy through presentations. Workshops are designed in conjunction with local education agencies.

3. SCHOOL LEVEL

All grade levels

4. FOCUS

The program is designed to educate teachers about energy and instruct them in how to incorporate energy-related concepts into their classroom.

5. IMPACTS

A. TEACHER KNOWLEDGE

Teachers learn background information about energy concepts and are given sources of materials for teaching.

B. CLASSROOM APPLICATION

Presenters give teachers materials and help teachers learn how to apply this information in the classroom. Teachers practice classroom activities by doing hands-on learning in the workshop.

6. REFERENCE

Programs (1983). Energy and Man's Environment (National Energy Foundation Programs)

Materials sent by:

Dari Scott
Program Administrator
National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, Utah 84116

1. PROGRAM NAME AND SPONSOR

University/College Level Programs
The National Energy Foundation (NEF)

2. TYPE OF PROGRAM

Teachers attend courses at college or universities that are developed in collaboration with Energy and Man's Environment, a nonprofit energy education organization of the NEF.

3. SCHOOL LEVEL

All grade levels

4. FOCUS

Teachers obtain course credit and learn about specific content areas and techniques for teaching energy concepts.

5. IMPACTS

A. TEACHER KNOWLEDGE

Teachers gain knowledge in specific energy content areas.

B. CLASSROOM APPLICATION

Teachers learn how to instruct children in energy concepts. They also often develop lesson plans to share with other class members. Finally, they participate in and learn about field trips for their students.

6. REFERENCE

Programs (1983). Energy and Man's Environment (National Energy Foundation Programs)

Materials sent by:

Dari Scott
Program Administrator
National Energy Foundation
5225 Wiley Post Way, Suite 170
Salt Lake City, Utah 84116

1. PROGRAM NAME AND SPONSOR

The National Leadership Program for Teachers (NLPT)
The Woodrow Wilson National Fellowship Foundation

2. TYPE OF PROGRAM

Teachers attend a summer institute at Princeton University. Following the institute, teachers have the opportunity to be involved in outreach projects in their own communities. Teachers also may disseminate what they learned in the institute through presenting at 1-week Teacher Outreach institutes (TORCH) to groups of other teachers. A third component of the program is a followup session of at least 1 day for teachers to renew their relationship with other teachers and share their experiences.

3. SCHOOL LEVEL

Middle and high school

4. FOCUS

The program trains expert teachers and helps them train other teachers throughout the country.

5. IMPACTS

A. TEACHER KNOWLEDGE

Some of the main goals of the program are to provide a heavy concentration in science, math, and history, expend teachers' knowledge, and increase teachers' professional status.

B. CLASSROOM APPLICATION

Another goal is to promote teaching methods to stimulate the learning of all students and involve them in their learning. The program stresses using technology in the classroom. There is also time devoted to learning about classroom management.

C. TEACHER NETWORKING

One of the purposes of the followup session is for teachers to renew their relationships with one another. Teachers also have networking opportunities through their outreach experiences.

D. LEADERSHIP AND EMPOWERMENT

The program helps teachers teach other teachers throughout the country.

E. STUDENT OUTCOMES AND ACHIEVEMENT

Increasing student achievement is an underlying goal of the program.

6. REFERENCE

Webb, N. (1994). Impact of the National Science, History, and Mathematics Leadership Program: One Week Summer Institutes, 1993.

The above report and other materials provided by:

Dale Stewart Koepp
Director, National Leadership Program for Teachers
The Woodrow Wilson National Fellowship Foundation
PO Box 5281
Princeton, NJ 08543-5281

1. PROGRAM NAME AND SPONSOR

The Urban Mathematics Collaborative (UMC)
The Ford Foundation

2. TYPE OF PROGRAM

The UMC project established 16 collaboratives with a core structure of a host agency, a set of goals, a group of eligible teachers, activities, and some participation from institutions of higher education, business, and the school district. Although there is a basic structure, collaboratives formed their own models. Collaboratives varied from site to site, but all involved teachers, administrators, businesses, and college and university educators.

3. SCHOOL LEVEL

Secondary

4. FOCUS

The purpose of the UMC was to make mathematics education better in inner-city school and to find new models to meet teachers' professional needs. A premise of the program was that mathematics teaching would improve if the status of teachers improved and if there was a structure for teachers to learn about advances in mathematics education and applications in business and industry.

5. IMPACTS

A. TEACHER KNOWLEDGE

A goal of the program was to inform teachers of new developments in mathematics.

B. CLASSROOM APPLICATION

Another goal of the UMC was to promote new teaching methods that incorporate ideas from the current reform movement.

C. TEACHER NETWORKING

Another goal of the program was to make teachers less isolated.

D. LEADERSHIP AND EMPOWERMENT

Leadership was not a specific goal, but rather a byproduct of activities in the collaborative.

E. STUDENT OUTCOMES AND ACHIEVEMENT

An underlying goal of the program was to increase student achievement.

F. MINORITY PARTICIPATION

The program was designed for teachers in inner-city schools in which there is a high minority enrollment. Because inner-city teachers are often isolated, an important goal was to connect these teachers with mathematicians, reformers, administrators, and other teachers.

6. REFERENCE

Webb, N., and Romberg, T. (1984). Reforming Mathematics Education in America's Cities: The Urban Mathematics Collaborative Project. New York: Teachers College Press.

APPENDIX B

TEACHER ENHANCEMENT PROGRAMS WITH EVALUATION COMPONENTS

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Index of Teacher Enhancement Programs with Evaluation Components

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1. PROGRAM NAME AND SPONSOR

NSF Teacher Enhancement Program (TE)

2. TYPE OF PROGRAM

599 inservice teacher education programs in science and math education.
90% operated during the summer, where participants received approximately 120 hours of training.
85% also offered programs during the school year, where participants received about 24 hours of trainings.
About 25% also included post-summer independent study.
86% emphasized hands-on activities, 45% emphasized small-group discussions, and 43% emphasized the development of student instructional materials.
Teaching methods also included cooperative learning groups (42%), lectures (42%), instructor demonstrations (39%), and small group discussion sections (35%).

3. SCHOOL LEVEL

Elementary, middle/junior high, and secondary

4. NUMBER OF TEACHERS

The training of more than 63,000 science and math teachers were trained under NSF awards between FY 1984 and 1989.
(2,396 questionnaires were completed for this evaluation - 59% response rate from a sample of 4,309).

5. FOCUS

The primary focus of the TE projects was on biological, physical, and earth sciences and mathematics, with other sciences covered to a lesser degree.
The goals most frequently cited by project directors were

- improving teachers' knowledge of science and mathematics content;
- providing teachers with experience in hand-on instructional activities;
- developing ways for teachers to enhance student interest in science or mathematics;
- developing teacher skills for improving student problem solving.

6. EVALUATION MODEL

Project director survey and participant survey.

7. IMPACTS

A. PARTICIPANT SATISFACTION

81% of respondents would strongly recommend the program to other teachers.

B. TEACHER KNOWLEDGE

In the participant survey, 60% reported improvement in their knowledge of math and science content, 58% reported increased knowledge of the application of math and science principles.
In the project director survey, 81% reported that participants increased their knowledge of science and math content, and 63% reported that they increased their knowledge of the applications of science or math principles.

C. CLASSROOM APPLICATION

61% of participants reported learning about materials they had used in the classroom.
80% reported using more hands-on activities.
75% reported having students work more in small groups.
71% integrated the applications of math and science into their teaching more.
69% helped students more to find answers to their own questions.
61% conducted more scientific demonstrations for their students.
52% used computers more.

D. TEACHER NETWORKING

Approximately 70% reported that they had learned a lot from working with other teachers, although only 20% indicated that they had remained in contact with other participants.

E. LEADERSHIP AND EMPOWERMENT

40% of participants indicated that they had established working partnerships with other institutions, such as university faculty.

60% reported serving as a mentor to other teachers in their schools, 44% reported making presentations to teachers outside their schools; 47% had become master teachers, 25% curricula specialists, and 41% department heads.

F. STUDENT OUTCOMES AND ACHIEVEMENT

Participants reported the following increases in their students attitudes and behaviors as a result of the changes they had made in their teaching:

enthusiasm in class (80%)
classroom test scores (52%)
interest among students in careers in math and science (49%)
involvement in projects outside of class (43%)
participation in science fairs or contests.

Between one-half and two-thirds of the participants believed that their TE experience had had a major or great impact on these student changes.

G. MINORITY PARTICIPATION

7.9% black, 3.3% Hispanic, 2.2% Asian or Pacific Islander, and 1.1% American Indian or Alaskan.

8. COMMENTS ON EVALUATION

Based on followup questionnaires of participants and project directors.

9. REFERENCE

Abt Associates, Inc. (1993). *A Study of NSF Teacher Enhancement Programs (TE) Participants and Principal Investigators: 1984-89.* National Science Foundation.

1. PROGRAM NAME AND SPONSOR

Making Math Leaders: The San Francisco Math Leadership Project.
Funded by the Sate of California.

2. TYPE OF PROGRAM

Year-long program to develop leadership among K-8 mathematics teachers. Program begins with intensive 4-week summer institute and continues with monthly meetings during the year and classroom visits. Teachers must present two workshops at their school sites.

3. SCHOOL LEVEL

Elementary

4. NUMBER OF TEACHERS

98, over a 4-year period.

5. FOCUS

Designed to

1. Improve mathematical problem-solving skills, build confidence, and increase classroom effectiveness;
2. Provide participants with ongoing training; and
3. Provide support for teachers as they develop workshops for colleagues.

6. EVALUATION MODEL

1. Pre-institute Questionnaire and End of First/Second Year Form
2. Knowledge of Math pre-test/post-test
3. Daily evaluations of summer institute
4. Final evaluation of summer institute
5. Evaluation of monthly followup meetings
6. Feedback from teaching colleagues and parents who attended workshops provided by participants
7. Self-evaluation of own classroom and impact of project on own teaching practices
8. Information on math-related activities pursued during the school year.

7. IMPACTS

A. PARTICIPANT SATISFACTION

All respondents in one cohort (n=11) marked "5" (the highest) in response to statement, "enjoyment of mathematics teaching."
All daily evaluations of summer institute rated them as "highly effective."

B. TEACHER KNOWLEDGE

Regarding how the project had increased skills and knowledge in 18 specific areas, on 5-point scale, mean response to all but 4 items was 4.0 or higher.
All but 2 of the 98 participants had improved scores on the math knowledge test developed from the California Assessment Program of the California State Department of Education Survey of Academic Skills, Grade 8.
Participants also reported that the institute served to increase their skills on both math content and teaching strategies.

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C. CLASSROOM APPLICATION

On mathematics teaching strategies - using year-end self-evaluation questionnaires concerning 15 practices, statistically significant differences (paired comparison t-tests) were reported for 11 of the items, ranging from "feeling enthusiastic about the subject" to "stress problem solving process rather than solutions."

Self-evaluation of own classroom and impact of project on teaching practices - All participants rated selves as "good" to "excellent" in target areas, indicating confidence in incorporating the project strategies into ongoing curriculum.

D. TEACHER NETWORKING

Participants' comments highlighted that the "best" aspect of the institute was the opportunity for sharing ideas with colleagues. This was also true regarding the monthly meetings during the school year.

E. LEADERSHIP AND EMPOWERMENT

In self-reports, participants indicated that they viewed themselves as emerging math leaders in their schools.

Dramatic increase in teacher participation in professional associations. Participants from each project year saw themselves emerging as math leaders in their schools.

8. COMMENTS ON EVALUATION

Real improvement in teacher knowledge documented in pre-/post-test data on math test given prior to the workshop and at the end of the year. Also, increase in attendance and/or membership in professional organizations and development activities. Other outcomes of workshops based on self-report.

9. REFERENCE

Armstrong, P. (1987). *Making Math Leaders: The San Francisco Math Leadership Project*. ERIC Document No. 289-715.

1. PROGRAM NAME AND SPONSOR

Environmental Science Education Program
NSF

2. TYPE OF PROGRAM

Thirty-two 2.5-hour class sessions in environmental science education program. Participants also attended two field trips.

3. SCHOOL LEVEL

Elementary and middle school.

4. NUMBER OF TEACHERS

51 inservice teachers and 51 control group teachers.

5. FOCUS

a. Improve environment science content knowledge.
b. Aid teachers in identifying environmental science education resource materials.
c. Develop and maintain cooperation, communication, and support between scientists at U. of Texas and school teachers.
d. Improve teachers' attitudes toward environmental science and science education.

6. EVALUATION MODEL

Pre-test, mid-test, and post-test using the "Views of Science" instrument - an instrument designed to assess the philosophical view of science as reflected in either tentativeness about science or views on the absolute nature of science (developed as part of a doctoral dissertation) - and the Environmental Education Questionnaire.

Control group consisted of teachers selected by participants in the same school and grade.

7. IMPACTS

A. TEACHER KNOWLEDGE

Significant difference between two groups on attitudes toward environmental science education, but no difference in Views on Science measures.

8. COMMENTS ON EVALUATION

Well-designed, limited focus evaluation on goal of improving attitudes toward science and environmental education.

9. REFERENCE

Bethel, L.J., Ellis, J.D., and Barufaldi, J.P. (1982). The Effects of a NSF Institute on Inservice Teachers' Views of Science and Attitudes Toward Environmental Science Education. *Science Education*, 66 (4), 643-51.

1.	**PROGRAM NAME AND SPONSOR**
	Department of Energy Workshops DOE
2.	**TYPE OF PROGRAM**
	Summer energy workshop
3.	**SCHOOL LEVEL**
	Secondary
4.	**NUMBER OF TEACHERS**
	50 participants in the DOE workshops, and 29 peer teachers who attended inservice workshops conducted by the participants at their home schools.
5.	**FOCUS**
	Current education practices and practices relating to energy education.
6.	**EVALUATION MODEL**
	Two followup mail surveys: the Energy Education Survey for Participants and the Energy Education Survey for Peer Teachers.
7.	**IMPACTS**
A.	**CLASSROOM APPLICATION**
	Participants included significantly more energy education topics in their curricula and used significantly more industry- or business-produced energy education materials and self-produced units after workshop.
B.	**LEADERSHIP AND EMPOWERMENT**
	Participants conducted workshops for peer teachers, who also included more energy education topics in their curricula.
8.	**COMMENTS ON EVALUATION**
	Findings based on self-report only.
9.	**REFERENCE**
	Bitner-Corvin, B.L. (1983). *Impact Study of Energy Education Workshops on the Participants and their Peer Teachers.* ERIC Document No. 295-798.

1.	**PROGRAM NAME AND SPONSOR**
	A year-long inservice science workshop Education for Economic Security Act Grant.
2.	**TYPE OF PROGRAM**
	33 hours of inservice during the school year.
3.	**SCHOOL LEVEL**
	K-7
4.	**NUMBER OF TEACHERS**
	33
5.	**FOCUS**
	Belief that attitude toward science and science teaching influences the teaching of science. Goal was to improve attitudes of K-7 teachers toward science and science teaching.
6.	**EVALUATION MODEL**
	Pre-/post-test using the Science Attitude Scale for Inservice Elementary Teachers - II and participants' written cognitive responses.
7.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	Statistically significant change in attitudes about and apprehensions toward science.
8.	**COMMENTS ON EVALUATION**
	Reasonable design and analysis plan. No followup to determine lasting effects of workshop. No evidence that attitude change affected classroom teaching.
9.	**REFERENCE**
	Bitner-Corvin, B. (1986). *Yearlong Inservice Science Workshop: Its Effect on the Attitudes of Teachers K-7.* ERIC Document No. 295-797.

1. PROGRAM NAME AND SPONSOR

ENLIST Micros for Rural Schools.
NSF

2. TYPE OF PROGRAM

Three-year, train-the-trainer model designed to help K-12 teachers implement microcomputers in school science instruction.
Used in rural schools in Kansas.
Included 2-day introductory workshops, 4 half-day seminars midyear, and onsite implementation assistance throughout the year.

3. SCHOOL LEVEL

Elementary and secondary.

4. NUMBER OF TEACHERS

14, 6 women and 8 men from 6 school districts.

5. FOCUS

Determine appropriate use of the ENLIST Micros model for rural schools.
Examine the effectiveness of the model in terms of changing teacher beliefs and behaviors.

6. EVALUATION MODEL

The Microcomputer Use in Science Teaching was administered to obtain specific information about teacher behaviors and usage of computers.
Also a Microcomputer Utilization in Science Teaching Efficacy Beliefs Inventory was used to measure teachers' beliefs toward the use of microcomputers in science teaching.

7. IMPACTS

A. TEACHER KNOWLEDGE

Teacher beliefs regarding the effectiveness of microcomputers as an instructional tool significantly increased.

B. CLASSROOM APPLICATION

Frequency of microcomputer use in science teaching was significantly increased after completion of the ENLIST project.

8. COMMENTS ON EVALUATION

Evaluation targeted outcomes and measured them appropriately. Sound data analyses employed.

9. REFERENCE

Borchers, C. A., Shroyer, M. G., and Enochs, L. G. (1992). A Staff Development Model to Encourage the Use of Microcomputers in Science Teaching in Rural Schools. *School Science and Mathematics.* 92 (7), 384-390.

1. PROGRAM NAME AND SPONSOR

Science Teachers Research Involvement for Vital Education (STRIVE)
NSF and U.S. Dept. of Energy, administered by Oak Ridge Associated Universities.

2. TYPE OF PROGRAM

8-week summer program where science and math teachers worked as full-time researchers in R & D projects.

3. SCHOOL LEVEL - Secondary

4. NUMBER OF TEACHERS - 23

5. FOCUS

Create a better understanding of how scientific knowledge is applied in a lab environment, enhance teachers' professional competence, and thereby improve the quality of education for student.

6. EVALUATION MODEL

Pre-test/post-test in which teachers rated themselves in the following areas: use of various teaching activities, knowledge, understanding, awareness, interest, and confidence in science areas, and number of students completing independent research or science projects.
Followup surveys of participants and school principals.

7. IMPACTS

A. PARTICIPANT SATISFACTION

Both participants and school principals reported that the program was successful in followup surveys.

B. TEACHER KNOWLEDGE

Significant increase in teachers' reported knowledge about research and application of science and math outside classroom, awareness of relationship of subject to industry and careers, and interest in research and applied science.

C. CLASSROOM APPLICATION

No increase in frequency with which participants utilized various teaching activities.
Significant increase in time devoted to lab activities in classes.

D. LEADERSHIP AND EMPOWERMENT

Increase in confidence in teaching science, but not significant.

E. STUDENT OUTCOMES AND ACHIEVEMENT

No increase in students completing independent science fair projects.

8. COMMENTS ON EVALUATION

Based on self-report.

9. REFERENCE

Boser, J.A., et al. (1988). *The Effect of Active Research Involvement on Secondary Science and Mathematics Teachers.* ERIC Document No. 303-338.

1.	**PROGRAM NAME AND SPONSOR**
	Project IMPACT (Increasing the Mathematical Power of All Children and Teachers): Three-Year Longitudinal Effects on Student Math Achievement Originally funded by NSF
2.	**TYPE OF PROGRAM**
	Cooperative project between the University of Maryland and the Montgomery County Public Schools, Rockville, MD. The program involved 3 years of school-wide teacher enhancement activities in mathematics education. It included 22-day summer program, ongoing teacher support during the school year, instruction materials, and modified school scheduling to permit collaborative planning time for all participating teachers.
3.	**SCHOOL LEVEL**
	K-3 (1,350 students total)
4.	**NUMBER OF TEACHERS**
	52
5.	**FOCUS**
	Object of the project is to design, implement, and evaluate a model for elementary mathematics instruction that will enhance student understanding and support teacher change in predominantly minority schools.
6.	**EVALUATION MODEL**
	Six urban schools were selected: three were randomly assigned to the treatment group, and three to the control group. A series of performance assessments, developed by the evaluators using the Curriculum and Evaluation Standards for School Mathematics were administered to all 3rd grade students. No pretests were administered.
7.	**IMPACTS**
A.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	Students who had been in the IMPACT program for 2 or more years demonstrated improved math achievement as measured by the assessments developed for the evaluation.
b.	**MINORITY PARTICIPATION**
	Program specifically designed for urban schools with high minority populations.
8.	**REFERENCE**
	Campbell, P.F., Larson, J.C., and Rowan, T.E. (1994). *Project IMPACT: Three-Year Longitudinal Effects on Student Math Achievement*. Paper presented at the Annual Meeting of the American Educational Research Association, April 6, 1994, New Orleans, LA.

1.	**PROGRAM NAME AND SPONSOR**
	Cognitively-Guided Instruction (CGI)
2.	**TYPE OF PROGRAM**
	Month-long summer workshop
3.	**SCHOOL LEVEL**
	First grade
4.	**NUMBER OF TEACHERS**
	40 - 20 were in the treatment group who attended the summer workshop, and 20 were in a control group to which no instruction was given.
5.	**FOCUS**
	To determine whether providing teachers access to explicit knowledge derived from research on children's thinking in a specific content domain would influence the teachers' instruction and their students' achievement.
6.	**EVALUATION MODEL**
	Randomized design with a treatment and control group of teachers and outcome measures that included student assessments and classroom observation.
7.	**IMPACTS**
A.	**CLASSROOM APPLICATION**
	Classroom observation indicated, even though specific instruction patterns were not prescribed, that CGI classes spent more time talking about problems and discussing alternate solutions than did the control classes.
B.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	Students in the two groups performed comparably on tests of computational proficiency, but the CGI students performed better on complex addition and subtraction that are not typically part of first-grade curricula. CGI students also scored higher on measures of number fact knowledge, problem solving, reported understanding, and reported confidence in their problem solving.
8.	**COMMENTS ON EVALUATION**
	Well-designed study with clearly identified goals and appropriate outcome measures.
9.	**REFERENCE**
	Carpenter, T.P., et al. (1989). Using Knowledge of Children's Mathematics Thinking in Classroom Teaching: An Experimental Study. *American Education Research Journal,* 26 (4), 499-531.

1.	**PROGRAM NAME AND SPONSOR**
	Valley Crest Project
2.	**TYPE OF PROGRAM**
	Collaborative teacher/university researcher program in mathematics.
3.	**SCHOOL LEVEL**
	Elementary
4.	**NUMBER OF TEACHERS**
	1
5.	**FOCUS**
	Designed to help change teacher's instructional ideas and behaviors. The teacher observed researchers, identified problem areas to work on, co-taught with the researcher, and received long-term support after project was over.
6.	**EVALUATION MODEL**
	Pre-/post-test student achievement tests. Interviews with students and student notebooks.
7.	**IMPACTS**
A.	**CLASSROOM APPLICATION**
	Based on classroom observation - Instruction became more student centered and constructivist; Instructor's role became that of question asker and problem poser; Problem solving, persistence, and resourcefulness on part of students became highly valued.
B.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	Quantitative - Valley Crest Mathematics Inventory used for student pre- and post-test data. Near doubling in student performance in areas of extended math (pre-algebra) problems, miscellaneous problems, and estimation. Even though geometry and statistics were not presented during the year, scores in these areas increased. A t-test on scores found a mean difference of 13.95, t=7.93 (sig. beyond .001 level). Qualitative (interviews and student notebooks) - Students indicated an increase in self-posed problems as opposed to teacher-directed problems. Increase in motivation to solve own problems. Marked shift toward successful independent problem solving.
8.	**COMMENTS ON EVALUATION**
	Only based on one teacher's experience. Student outcomes could be attributed to other variables for which there were no controls.
9.	**REFERENCE**
	Connell, M.L. (1992). *True Collaboration: An Analysis of an Elementary School Project in Mathematics.* ERIC Document No. 355-091.

1.	**PROGRAM NAME AND SPONSOR**
	Summer Institute in Science Texas Higher Education Coordinating Board
2.	**TYPE OF PROGRAM**
	3-week summer program in science education
3.	**SCHOOL LEVEL**
	Elementary and secondary
4.	**NUMBER OF TEACHERS**
	58
5.	**FOCUS**
	Theory of Reasoned Action used to justify that behavioral change is the result of changed beliefs. Improve teachers' understanding of physics and chemistry concepts; improve 5th-6th grade teachers' understanding of science and the use of science activities; train high school teachers in use of activities and investigations; update teachers' knowledge of recent research.
6.	**EVALUATION MODEL**
	Pre-/post-test evaluation using a Content Test and an Activities and Investigations Questionnaire to measure the participants' intentions to use activities and their attitudes toward the materials. No followup on actual use of materials, however.
7.	**IMPACTS**
A.	**PARTICIPANT SATISFACTION**
	Teachers felt strongly that the institute was successful, and that it accomplished its goals.
B.	**TEACHER KNOWLEDGE**
	Teachers significantly increased their content knowledge.
C.	**CLASSROOM APPLICATION**
	Teachers expressed intentions to use the information and materials developed in the courses.
8.	**COMMENTS ON EVALUATION**
	Self-report of intention to use the materials was the only measure of classroom impact.
9.	**REFERENCE**
	Crawley, F. (1988). *Institute in Physical Science: A Category 1 Summer In-Service Program for Elementary and Secondary Teachers of Physical Science.* ERIC Document No. 307-126.

1. PROGRAM NAME AND SPONSOR

Developmental Approaches in Science and Health (DASH)
National Science Foundation, the Hawaii Department of Business, Economic Development and Tourism, and the University of Hawaii.

2. TYPE OF PROGRAM

10-day institutes combining theory, pedagogy, instruction in content, and modeling of instructional strategies. Also, a 2-year support program consisting of monthly meetings of DASH teachers with project-trained facilitators.

3. SCHOOL LEVEL

K-6.

4. NUMBER OF TEACHERS

Six teachers were included in the evaluation. However, the program has been implemented in 500 schools in 14 states.

5. FOCUS

Develop scientifically literate students by:

_ facilitating learning of the basic concepts of science, health, and technology;
_ facilitating use of skills and knowledge of science in personal and social contexts;
_ engaging students of a wide range of backgrounds, abilities, and learning styles in inquiry-based activities.

Train teachers to use instructional materials that enable them to:

_ effectively teach science to heterogeneous groups of students;
_ integrate science, health, and technology in a practical, understandable way;
_ change approaches to teaching elementary science in ways that focus on students' learning and increase instructional time spent on science.

6. EVALUATION MODEL

Six classrooms were chosen for evaluation. Sites were selected by previous observation as implementing DASH with fidelity to the program design and pedagogy.
Evaluation included over 200 observer hours over a 5-day period in classrooms that were videotaped for later analysis. Also, interviews with teachers, administrators, and students.
Standardized achievement test data were also available at some sites.

7. IMPACTS

A. CLASSROOM APPLICATION

Teachers changed their attitudes and approaches toward elementary science in ways that result in increased instructional time spent on science and focus on students' learning.

B. STUDENT OUTCOMES AND ACHIEVEMENT

Students demonstrate understanding of fundamental concepts and use of essential skills in science, health, and technology.
Students are also more self-directed learners as reflected in engaged learning time, planning and completion of tasks, and use of multiple resources in problem solving.

C. MINORITY PARTICIPATION

A high percentage of minority students and teachers have participated in the DASH program.

8. COMMENTS ON EVALUATION

Case-study report based on site-visits to six classrooms.

9. REFERENCE

Curriculum Research and Development Group. (1993). *Developmental Approaches in Science and Health (DASH)*, University of Hawaii, Honolulu, HI.

1. PROGRAM NAME AND SPONSOR

Applications of Basic Science in Industry and Society to Enhance Secondary School Science.
A National Science Foundation Workshop

2. TYPE OF PROGRAM

3-week summer workshop and a year-long series of seven seminars.

3. SCHOOL LEVEL

Secondary chemistry and biology teachers.

4. NUMBER OF TEACHERS

20 chemistry and 20 biology

5. FOCUS

1. Stimulate effective teaching approaches.
2. Build curriculum units from industrial and societal application.
3. Provide training for teacher-leaders who will be encouraged to provide leadership in their schools.
4. Develop long-range networking opportunities.
5. Provide impetus for development of long-term collaborative relationships between secondary science teachers, college scientists, and industry and government affiliated scientists.

6. EVALUATION MODEL

Followup participant questionnaire.
An instrument, "Our Class and Its Work (OCIW)," was used to gather information from students about their perceptions of classroom approach. This included collecting data from students of participants and students of a control group of teachers.
Interviews with teachers and administrators at the schools.
Experienced teachers were ranked significantly higher on the OCIW than inexperienced teachers on both pre- and post-test measures.

7. IMPACTS

A. PARTICIPANT SATISFACTION

Participants rated the workshop experience as "extremely valuable."

B. CLASSROOM APPLICATION

Sixty-one percent of the teachers reported utilizing the activities targeted by the workshop and designed to promote constructionists approaches to teaching.
Students' perceptions of classroom approach paralleled teacher self-reports; when teachers reported a change in classroom behavior, OCIW student data supported a change as well (.01 level of significance when compared to non-NSF teachers).

C. TEACHER NETWORKING

Survey data showed that participants rated the workshops most highly on the opportunity it gave them to work with university scientists and other teacher participants.

D. LEADERSHIP AND EMPOWERMENT

The majority of participants reported that they shared their project experience and materials with other teachers.

E. STUDENT OUTCOMES AND ACHIEVEMENT

Pre- and post-tests of the OCIW instrument administered to students in classes conducted by workshop participants revealed that the intervention stimulated student attitudes and improved student achievement when compared to the performance on this assessment of students in classes taught by nonparticipants. Results also indicated an increase in interest in science in the students of workshop participants.

8. COMMENTS ON EVALUATION

Utilized more than test scores as a measure of student outcomes. Compared student perceptions of teachers' classroom behaviors with the self-reports of teachers.

9. REFERENCE

Eash, M.J., Hagar, W., and Weigrecht, W. (1989). *Determining Outcomes for Evaluation of a National Science Foundation Workshop.* ERIC Document No. 312-315.

1.	**PROGRAM NAME AND SPONSOR**
	Mathematics Institute Program
2.	**TYPE OF PROGRAM**
	16-week course and 4-week practicum that enabled teachers to learn math content from selected topics in math and to practice innovative ways of teaching math. Teachers who took the course participated in a 4-week clinical experience that included 4th-6th graders. This provided an opportunity for teachers to plan in cooperative teams and practice the pedagogical skills learning in a real setting.
3.	**SCHOOL LEVEL**
	Elementary
4.	**NUMBER OF TEACHERS**
	45 teachers and 10 preservice teachers.
5.	**FOCUS**
	Increase the mathematics knowledge and pedagogical skills of elementary school teachers. Develop a cadre of math teachers who can train other teachers. Show teachers how to integrate the Curriculum and Evaluation Standards of the NCTM into already-existing curriculum.
6.	**EVALUATION MODEL**
	Teachers were evaluated using a "Reaction Questionnaire" that indicated the effectiveness of the program. Teacher knowledge outcomes were measured using a 10-item word problem test developed to evaluate the content of the course.
7.	**IMPACTS**
A.	**PARTICIPANT SATISFACTION**
	80% of all participants considered the Mathematics Institute to be effective. 75% reported less anxiety toward math after the course.
B.	**CLASSROOM APPLICATION**
	50% reported that they had tried a new teaching strategy or had changed their teaching style.
C.	**LEADERSHIP AND EMPOWERMENT**
	Teachers conducted workshops in their respective schools following the institute.
8.	**COMMENTS ON EVALUATION**
	While participants did teach clinics to students, no student measures were taken. No reporting of teachers' performance on the word problem test.
9.	**REFERENCE**
	Garner-Gilchrist, C. (1993). Mathematics Institute: An Inservice Program for Training Elementary School Teachers. *Action in Teacher Education*, 15 (3), 56-60.

1. PROGRAM NAME AND SPONSOR

NSF-sponsored energy education inservice program.

2. TYPE OF PROGRAM

Energy education inservice project conducted during 30 weekly sessions.

3. SCHOOL LEVEL

Elementary

4. NUMBER OF TEACHERS

27 (with 27 self-selected control group teachers).

5. FOCUS

Improve elementary school teachers' knowledge about energy.

6. EVALUATION MODEL

The Energy Inventory was used with a pre-test/post-test control group to determine if participants gained a significant amount of knowledge about energy and significantly changed their opinions about energy.

At the time of the post-test, participants were also asked to respond to the question "What changes have been brought about in your classroom as a result of your participation in this project?"

7. IMPACTS

A. TEACHER KNOWLEDGE

Significant changes in knowledge possessed and opinions held about energy were achieved.

B. CLASSROOM APPLICATION

Teachers reported that they had added more energy content, felt their information was more current, and felt more confident in presenting energy education topics than prior to workshop.

8. COMMENTS ON EVALUATION

Control group teachers were not applicants to the program.

9. REFERENCE

Glass, L.W. (1982). An Inservice Energy Education Program for Elementary School Teachers. *Journal of Research in Science Teaching*, 19 (6), 469-474.

1. PROGRAM NAME AND SPONSOR

Summer Mathematics Institute

2. TYPE OF PROGRAM

Twelve 5-hour sessions at the end of the school year.

3. SCHOOL LEVEL

elementary

4. NUMBER OF TEACHERS

18

5. FOCUS

Improve teachers' ability to provide meaningful, effective mathematics instruction.

6. EVALUATION MODEL

Pre-/post-test evaluation of the extent to which participants mastered the mathematical content presented in the 12-day institute and changed teaching behaviors as a result of improved mathematical knowledge. The tests were developed by the project directors.

7. IMPACTS

A. PARTICIPANT SATISFACTION

Participants enjoyed the course and had very positive feelings about it.

B. TEACHER KNOWLEDGE

Teachers significantly improved their understanding of math content.

C. CLASSROOM APPLICATION

Teachers reported that they integrated their newly acquired knowledge into their everyday teaching behaviors.

D. TEACHER NETWORKING

Reported enjoying the camaraderie and sharing ideas.

8. COMMENTS ON EVALUATION

All outcomes but teachers' content knowledge were based on teachers' self-report.

9. REFERENCE

Greabell, L. C., and Phillips, E.R. (1990). A Summer Mathematics Institute for Elementary Teachers: Development, Implementation, and Followup. *School Science and Mathematics*, 90 (2), 134-141.

1. PROGRAM NAME AND SPONSOR

Summer Mathematics Inservice Workshop

2. TYPE OF PROGRAM

5-day summer workshop for teachers in rural school districts in New Mexico.

3. SCHOOL LEVEL

Elementary

4. NUMBER OF TEACHERS

39 teachers - 50% of these were minorities.

5. FOCUS

1. Improvement of teacher instructional skills that impart knowledge and concepts to children through the use of manipulatives.
2. Improvement of teacher attitude towards the teaching of mathematics through an increase in confidence and a reduction in mathematics anxiety.
3. Participation by minority teachers, who can in turn then be more successful role models in mathematics for minority students.

6. EVALUATION MODEL

Pre-test at start of workshop and post-test on the last day. Focused on knowledge of math manipulative use, math confidence, and math attitude.
Followup visits to classes several weeks after school started, with anonymous questionnaire about project, effectiveness of materials, time spent teaching math, confidence, and whether teachers had conducted inservice at school.
Paired t-tests were used to compare pre-/post-test scores.

7. IMPACTS

A. PARTICIPANT SATISFACTION

Followup visits showed overwhelming compliments on the experiences of the workshop and usefulness of its content and materials.

B. TEACHER KNOWLEDGE

Significant differences in participants' knowledge of math manipulatives, math confidence, and math anxiety.

C. CLASSROOM APPLICATION

Over half of the teachers (59%) reported spending more time teaching math. Most of the teachers (88%) also reported using the materials from the workshop.

D. LEADERSHIP AND EMPOWERMENT

100% said they had shared math activities with peers, and 60% said they had conducted inservices.

E. STUDENT OUTCOMES AND ACHIEVEMENT

All of the participants (100%) reported that they had received positive responses about their math teaching from their students after they had attended the workshop. Nearly all of the teachers (90%) also reported students enjoying math more.

F. MINORITY PARTICIPATION

50% of participants were minority, with goal that they become role models for minority students.

8. COMMENTS ON EVALUATION

Effective use of a short-term workshop with reasonable goals and appropriate followup measures.

9. REFERENCE

Hadfield, O. D. (1992). Improving Elementary Teacher Performance and Confidence in Mathematics: A Successful Rural Small School Inservice. *Journal of Rural and Small Schools*, 5(2), 32-37.

1.	**PROGRAM NAME AND SPONSOR**
	Urban Mathematics Collaborative Ford Foundation
2.	**TYPE OF PROGRAM**
	Sixteen Urban Mathematics Collaboratives followed over a 5-year period.
3.	**SCHOOL LEVEL**
	Secondary
4.	**NUMBER OF TEACHERS**
	Over 3,000
5.	**FOCUS**
	Mathematics education reform through "empowering teachers in urban schools by fostering collaboration among teachers, mathematicians, and representatives of the business community in order to reduce teachers' sense of isolation, encourage professional enthusiasm and innovation in teaching, and expose these teachers to new developments and trends in mathematics and instruction."
6.	**EVALUATION MODEL**
	Telephone interviews with collaborative key personnel at 16 sites. None of the collaboratives currently have an established mechanism for comprehensive evaluation.
7.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	Teacher goals and practices change as a result of contacts with other collaborative members and participants.
B.	**CLASSROOM APPLICATION**
	Improvements in teacher practices were reported in the classrooms of teachers who collaborated with teachers who had participated in the program.
C.	**TEACHER NETWORKING**
	Inherent part of the collaborative effort.
D.	**LEADERSHIP AND EMPOWERMENT**
	Not a specific goal, but a byproduct of the substantive activities that contribute to teachers' professional development.
E.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	Changes among students are not systematically documented at any site, but some empirical and anecdotal evidence of change is available -- "increased or broadened enrollment in higher math courses; increased post-secondary enrollment; increased enjoyment of math."
8.	**COMMENTS ON EVALUATION**
	No systematic evaluation of program in general, and limited amount at individual sites.
9.	**REFERENCE**
	Heck, D.J., Webb, N.L., and Martin, W. (1994). *Case Study of Urban Mathematics Collaborative: Status Report.* Wisconsin Center for Education Research.

1. PROGRAM NAME AND SPONSOR

National Science Resources Center (NSRC) Summer Leadership Institutes

2. TYPE OF PROGRAM

One-week summer Elementary Science Leadership Institutes for teams from school districts interested in implementing hands-on, inquiry-centered elementary science programs in their schools. The institutes were designed to provide school district leadership teams with information and resources that would help them develop and sustain a K-6 science program.

Participants are leadership teams selected because they had provided evidence that they were strongly committed to hands-on science instruction.

The teams included a superintendent or assistant superintendent for curriculum and instruction, a science coordinator or director of elementary education, an experienced classroom teacher who has demonstrated leadership at the school or in the district, and a scientist from an industrial corporation, federal research facility, college, or university that could work with the district to develop community support for the program.

3. SCHOOL LEVEL

Elementary

4. NUMBER OF TEACHERS

For the first three summers, 1989-91, a single institute was held each year for 14 or 15 sites. Teams from 42 different communities attended. In 1992 two separate, 1-week summer institutes were held for a total of 29 teams.

5. FOCUS

Goals of the NSEL Initiative are to

- Identify and prepare a talent pool of leaders in the education and scientific communities to direct science education reform efforts;
- Provide technical assistance to school districts that are actively working to improve their science programs;
- Disseminate information about high quality science teaching resources and sources of assistance to educators and scientists through the country;
- Stimulate policy and program changes in school districts that will lead to the introduction of high quality, hands-on science programs.

6. EVALUATION MODEL

The evaluators identified five components of the institute as possible benchmarks for monitoring the participants' progress toward implementing effective, district-wide, hands-on science programs. These are appropriate curriculum, inservice education, materials support systems, active assessment, and administrative and community support.

The methodology used is a qualitative, naturalistic approach, stressing first-hand observation.

Written questionnaires from all participating districts, phone interviews (with half of team leaders), and a small group of documentation sites.

7. IMPACTS

A. PARTICIPANT SATISFACTION

Attendance is seen by almost all participants as an important step in providing resources, skills, and validation for returning to their communities and carrying out elementary science education reform efforts.

B. CLASSROOM APPLICATION

Results indicated that the leadership communities have made significant progress toward developing hands-on, inquiry-centered curriculum. Sixty-two percent have a district-wide plan to implement such a program, and 30% have implemented significant portions of their plans.

Successful science materials support centers have been established at 71% of the participant sites.

Assessment methods are also changing, and most sites are at least beginning to think of using active assessments to monitor program implementation and children's learning.

8. COMMENTS ON EVALUATION

This evaluation reports research done after 2 years of a planned 4-year evaluation effort.

9. REFERENCE

Hein, G. (1994). *Community Elementary Science Reform after Attendance at Summer Leadership Institutes 1989-92.* National Science Resources Center, Washington, D.C.

1. PROGRAM NAME AND SPONSOR

Monterey Bay Area Mathematics Project
Part of the State of California Mathematics Project

2. TYPE OF PROGRAM

Summer Institute

3. SCHOOL LEVEL

Elementary and secondary

4. NUMBER OF TEACHERS

23

5. FOCUS

Improve the quality of mathematics teaching;
Develop mathematics teachers as leaders in order to disseminate strategies, ideas, and techniques;
Encourage appropriate attitudes.

6. EVALUATION MODEL

Daily evaluations during institute.
Exit interview and post-institute survey.
Telephone interviews a year after institute.
Survey of self-reported instructional practices in mathematics was conducted about one year after the institute. This was given to participants, a group of teachers trained by participants, and a comparison group of teachers.

7. IMPACTS

A. PARTICIPANT SATISFACTION

Overall positive assessment of the institute.

B. TEACHER KNOWLEDGE

Participants believed they had gained valuable skills, insights, and competencies.

C. CLASSROOM APPLICATION

Participants indicated that they had made changes in their teaching of math. Instructional practices of these teachers were more congruent with the California Mathematics Framework. However, other teachers at home schools who were trained by the participants did not show the same effect. Also, there was no difference between these teachers and the control group who had received no training. Barriers to change in instructional practices that were noted by participants were deficiencies in time, materials, equipment, appropriate instructional facilities, and class size.

D. LEADERSHIP AND EMPOWERMENT

Increase in participation in professional development activities related to mathematics. Participants also reported leadership in math education by conducting inservice sessions for other teachers.

8. COMMENTS ON EVALUATION

Most of the evaluation data was based on self-report of participants.

9. REFERENCE

Henderson, R. W., and Brown, N. (1987). *The Monterey Bay Area Mathematics Project: First Year Evaluation.* ERIC Document No. 295-782.

1. PROGRAM NAME AND SPONSOR

Inservice Program for Elementary Science Teachers at the University of Arizona
NSF (partial funding)

2. TYPE OF PROGRAM

Year-long science inservice for elementary teachers. Included 90 hours of on-campus instruction in content, laboratory activities, and acquisition of resource information and materials. The off-campus program involved weekly visits to participating teachers to observe them and review and critique materials.

3. SCHOOL LEVEL

Elementary

4. NUMBER OF TEACHERS

Not reported.

5. FOCUS

Expand teachers' understanding of physics and chemistry concepts and processes and to encourage more science teaching and science activities in their classrooms.

6. EVALUATION MODEL

Classroom observation; pre-/post-test assessment of science content knowledge; Science Teachers' Behavior Q-sort instrument to determine teachers' beliefs about the importance of specific behaviors in the classroom.

7. IMPACTS

A. TEACHER KNOWLEDGE

Nonsignificant increase in post-test scores over those of the pre-test. However, the test was developed specifically for the project, and items were chosen to test concepts that elementary school children should comprehend. A number of the participants got all items correct on both the pre- and post-tests.

B. CLASSROOM APPLICATION

Classroom observation revealed that participants were utilizing the suggested demonstrated laboratory activities. Results of the Q-sort are difficult to assess, but the authors conclude that certain teachers are more likely to benefit from this type of program than others.

C. TEACHER NETWORKING

Participants shared developed materials with other teachers in the inservice workshop.

D. LEADERSHIP AND EMPOWERMENT

Nothing was reported about sharing information and materials with nonparticipants.

E. STUDENT OUTCOMES AND ACHIEVEMENT

Reported that the total number of elementary exhibits at the Southern Arizona Regional Science Fair doubled over the preceding year.

8. COMMENTS ON EVALUATION

This evaluation used inappropriate measures of improvements in teacher knowledge and behavior. Also, exhibits at a science fair are not a good indicator of positive student outcomes.

9. REFERENCE

Horak, W.J., Blecha, M.K., and Enz, J. (1982). *An Inservice Program for Elementary Teachers: Components, Instructional Procedures, and Evaluation.* ERIC Document No. 216-882

1. PROGRAM NAME AND SPONSOR

Great Starts Mathematics Approach 1987-88.
New York City Board of Education.

2. TYPE OF PROGRAM

Principals, teachers, and paraprofessionals from two schools attended monthly mathematics workshops after school.

3. SCHOOL LEVEL

K-2

4. NUMBER OF TEACHERS

Evaluation of 20 classrooms believed to represent best program implementation.

5. FOCUS

Teaching mathematical relationships and concepts through directed play and exploration with concrete materials.

6. EVALUATION MODEL

Student achievement on Grade 2 Metropolitan Achievement Test.
Classroom observation.
Teacher ratings.

7. IMPACTS

A. PARTICIPANT SATISFACTION

90% said program had a major impact in influencing their understanding of ways to teach math;
75% said it had a major impact by providing a mathematics curriculum to guide planning throughout year;
Organizing and managing the classroom to emphasize math ideas was an impact for 45% of teachers.
Principals were also satisfied with the programs in terms of the teachers gaining a deeper appreciation of the teaching and learning math.

B. CLASSROOM APPLICATION

Evaluator observations showed differences between two schools that related to teaching style and philosophy prior to the workshops. See "Student Outcomes and Achievement" below.

C. TEACHER NETWORKING

Comment most often made about the professional development activities concerned the personal and professional benefits obtained from exchanging and sharing ideas with one another.

D. STUDENT OUTCOMES AND ACHIEVEMENT

Student achievement as measured by scores on the 2nd grade math test did not improve, but correlational analyses indicate some relationship between teaching techniques as observed in the classrooms and test scores. Children whose teachers used more product-oriented teaching techniques tended to have lower scores on the test than those whose teachers used process-oriented techniques.

8. COMMENTS ON EVALUATION

This evaluation included a correlational analysis of student outcomes in relationship to teaching strategies, and addressed the goals of the workshops and how they were manifested in the students' approach to problems. Measures were taken at the end of the school year during which the workshops took place.

9. REFERENCE
Jarvis, C. H., and Blank, B. B. (1989). *Great Starts Mathematics Approach 1987-88.* ERIC Document No. 316-399.

1. PROGRAM NAME AND SPONSOR

Excellence in Mathematics and Science Teaching for the Intermediate Grades
Indiana Commission for Higher Education.

2. TYPE OF PROGRAM

Year-long inservice beginning with 1-week workshop in June of 1987 and ending with 3-day workshop in June. Workshop staff visited classroom of participants during the school year.

3. SCHOOL LEVEL

Grades 3-6

4. NUMBER OF TEACHERS

20

5. FOCUS

Develop math and science leaders who could provide inservice workshops and consultation to other teachers.

6. EVALUATION MODEL

Written evaluations completed by participants, and interviews with a random selections of participants.

7. IMPACTS

A. PARTICIPANT SATISFACTION

Positive reaction to workshops reported.

B. TEACHER KNOWLEDGE

Teachers reported learning new ideas and new ways to teach math and science.

C. TEACHER NETWORKING

This was a valued aspect of the program, noted most often as a positive outcome by participants.

8. REFERENCE

Kloosterman, P., et al. (1988). *Excellence in Mathematics and Science Teaching for the Intermediate Grades: Report of a Long-Term Inservice Project.* ERIC Document No. 299-161.

1.	**PROGRAM NAME AND SPONSOR**
	Implementing the NCTM Standards for School Mathematics for the 21st Century Title II/Eisenhower Project (NSF funded followup activities at one elementary school that involved placing a resource teacher there for 20-30 hours/week.)
2.	**TYPE OF PROGRAM**
	Set of 6 workshops (1 for principals; 5 for teachers) during the school year on mathematics education
3.	**SCHOOL LEVEL**
	Elementary
4.	**NUMBER OF TEACHERS**
	131 teachers, 19 principals, 6 graduate students, and 2 other school administrators: 28 males and 126 females (some data on sex are not available.)
5.	**FOCUS**
	Helping teachers to implement the *Curriculum and Evaluation Standards for School Mathematics* outlined by the National Council of Teachers of Mathematics in 1989, emphasizing problem solving, mathematical reasoning, and number sense.
6.	**EVALUATION MODEL**
a.	Post-workshop questionnaires
b.	Comprehensive Workshop Series Questionnaire - focused on the extent to which innovations suggested by workshop speakers were being implemented in the classroom (30 teachers)
c.	Telephone interview after final workshop including questions on how workshop ideas were being shared and implemented in participants' classrooms (30 teachers).
7.	**IMPACTS**
A.	**PARTICIPANT SATISFACTION**
	Nearly all participants responded very positively to the workshops. Workshops "excited and inspired" them - these effects lasted for weeks and months after workshops.
B.	**CLASSROOM APPLICATION**
	Most valuable aspect of the workshops. According to data collected from a followup questionnaire that was mailed to participants after they had returned to teaching, nearly all participants used some of the ideas from the workshop, and most used many of the ideas presented. Teachers claimed to continue to use the techniques frequently.
C.	**LEADERSHIP AND EMPOWERMENT**
	Participants shared a great deal about their experiences with others who had not attended, mostly through informal avenues. Followup questionnaires and interviews indicated that participants shared what they had learned at faculty meetings and building inservice programs. Throughout the following year, participants served as recruiters, trainers, and supporters for the project.
D.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	Teachers reported improvements in student attitudes toward math as a result of the workshops. Student interest and enjoyment in math lessons increased.
E.	**MINORITY PARTICIPATION**
	Four black teachers attended two or more workshops.

8. COMMENTS ON EVALUATION

The evaluation is limited in that most of the data were obtained by self-report, there are no objective data on instructional outcomes, and there is minimal information about the long-term effectiveness of the project. The data do tell us about teachers' level of awareness, interest, enthusiasm, activity, comfort, confidence, and intentions. They cannot tell us much about the teachers' competence in carrying out the recommended changes.

9. REFERENCE

Kroll, D.L. (1990). *Implementing the NCTM Standards for School Mathematics for the 21st Century.* Indiana State Commission for Higher Education, Indianapolis. ERIC Document No. 325-389.

1. PROGRAM NAME AND SPONSOR

Science Teaching and Development of Reasoning
Center for the Development of Reasoning at the University of Massachusetts.

2. TYPE OF PROGRAM

Four all-day workshops (1 day a month during the school year), a 2-day workshop in June, and a followup workshop the following December.

3. SCHOOL LEVEL

Secondary

4. NUMBER OF TEACHERS

40

5. FOCUS

Promote the implementation of inquiry techniques in teaching secondary science. Provide teachers with the skills necessary to assess the reasoning levels of their students and use this in their teaching approach.

6. EVALUATION MODEL

A workshop Evaluation Questionnaire.
"Stages of Concern" Questionnaire assessed the stage of concern about an innovation.
Site visit evaluations.
Evaluation of materials developed by the participants.

7. IMPACTS

A. PARTICIPANT SATISFACTION

Participants felt positive about the approach used.

B. CLASSROOM APPLICATION

Evaluation of units handed in during the final session of the project indicated that the process of incorporation of the new ideas into the classroom was "not complete," but changes were beginning to happen.

C. TEACHER NETWORKING

All participants expressed that one important value of the workshops was the opportunity to meet together and discuss their experiences and ideas.

8. COMMENTS ON EVALUATION

The evaluation was an attempt to measure impact by looking at five components of the program:

a. Presentation of theory or description of a skill or strategy.
b. Modeling or demonstration of skills.
c. Practice in simulated and classroom settings.
d. Structured and open-ended feedback.
e. Coaching for application.

Evaluators indicated that they felt the project had succeeded in the first four components.

9. REFERENCE

Lombard, A.S., Konicek, R. D., and Schultz, K. (1985). Description and Evaluation of an Inservice Model for Implementation of a Learning Cycle Approach in the Secondary Science Classroom. *Science Education*, 69 (4), 491-500.

1.	**PROGRAM NAME AND SPONSOR**
	Support Teacher Program
2.	**TYPE OF PROGRAM**
	Staff development program for junior high school math and science teachers. Teachers were given over 60 hours of intensive preparation (including a summer program at Michigan State University) that included (a) updating their knowledge of current research on teaching and learning mathematics, and (b) providing background and guided practice in working with professional peers in a supportive role.
3.	**SCHOOL LEVEL**
	Junior high.
4.	**NUMBER OF TEACHERS**
	8
5.	**FOCUS**
	Increase teachers' mathematical knowledge, improve instructional practices, and prepare teachers to conduct staff development activities in their schools with their colleagues.
6.	**EVALUATION MODEL**
	Followup questionnaires and interviews - Teaching Style Inventory, Support Teacher Interview. These were administered at the start of the program, after 4 months, following a summer workshop, and at the end of the first school year. Observation of support teachers by outside observers. Student tests, written work, and verbal comments.
7.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	Teachers' thoughts and practices changes as a result of the program. Teachers increased their knowledge of and experience in effective instructional strategies and support techniques
B.	**CLASSROOM APPLICATION**
	Noted shift from an authoritarian model of teaching based on "transmission of knowledge" to a student-centered practice featuring "stimulation of learning."
C.	**LEADERSHIP AND EMPOWERMENT**
	Teaching colleagues of the support teachers were influenced in varying degrees by support teachers.
D.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	Student results at the end of the first year indicated a more positive attitude towards mathematics, an improved ability to solve problems, and increased conceptual understanding.
8.	**COMMENTS ON EVALUATION**
	The evaluation addressed the goals of the project and utilized reasonable ways of measuring outcomes.
9.	**REFERENCE**
	Madsen, A.L., and Lanier, P.E. (1992). *Improving Mathematics Instruction through the Role of the Support Teacher.* ERIC Document No. 353-128.

1.	**PROGRAM NAME AND SPONSOR**
	Focusing on Teachers: ESEA Title II Mathematics and Science in Austin Independent School District.
2.	**TYPE OF PROGRAM**
	12-month project included staff development workshops; consultant to develop a secondary scope and sequence; funds for teachers to attend professional workshops; materials and tuition for staff development workshops.
3.	**SCHOOL LEVEL**
	Elementary and secondary math and science
4.	**NUMBER OF TEACHERS**
	116 of participants completed questionnaires (78% response rate)
5.	**FOCUS**
	Improvement of math and science teaching at pre-K through grade 12 levels.
6.	**EVALUATION MODEL**
	Followup participant survey.
7.	**IMPACTS**
A.	**PARTICIPANT SATISFACTION**
	On followup questionnaires participants gave high ratings to the instructional materials used in the workshops.
B.	**CLASSROOM APPLICATION**
	Scope and sequence were developed for math and science, although there was no report as to whether it was later implemented.
C.	**LEADERSHIP AND EMPOWERMENT**
	High ratings were given to professional meetings.
8.	**REFERENCE**
	Marable, P. (1990). *Focusing on Teachers: ESEA Title II Mathematics and Science.* ERIC Document No. 325-520.

1. PROGRAM NAME AND SPONSOR

Mathematics-Science Integration Project: A Collaborative, Rural School Effort

2. TYPE OF PROGRAM

Series of four full-day math and science inservice workshops.

3. SCHOOL LEVEL

K-8

4. NUMBER OF TEACHERS

75 elementary, 35 middle/junior high school teachers, and 38 secondary school teachers.

5. FOCUS

1. Provide series of inservice workshops emphasizing math and science training in problem solving, integration, and use of technology;
2. Develop an awareness and strategy for increasing student participation in science and math, with attention to underrepresented populations;
3. Support professional development and attend professional conferences.

6. EVALUATION MODEL

Formative and summative evaluations.
Formative - Post-workshop evaluation questionnaires
Summative - Telephone and personal interviews of project staff, teacher center coordinator, and a random sample of math and science teachers.

7. IMPACTS

A. PARTICIPANT SATISFACTION

75% of participants or more rated each workshop as very worthwhile. Teachers rated workshops as highly successful on most measures.

B. TEACHER KNOWLEDGE

Teachers' ratings indicated strong evidence that they believed the information received in the workshops could be used in support of the education process.

C. CLASSROOM APPLICATION

New knowledge was reported to be worthwhile in classroom applications.

8. COMMENTS ON EVALUATION

Evaluation based on self-reports taken at the conclusion of the workshops.

9. REFERENCE

Mecca, P. M. (1991). *Mathematics-Science Integration Project: A Collaborative, Rural School Effort.* ERIC Document No. 342-623.

1.	**PROGRAM NAME AND SPONSOR**
	Confidence in Content Through Conceptual Change
2.	**TYPE OF PROGRAM**
	5-week summer program designed to develop conceptual understanding of physics.
3.	**SCHOOL LEVEL**
	Elementary
4.	**NUMBER OF TEACHERS**
	15
5.	**FOCUS**
	Understanding physics concepts. Model teaching techniques for teachers to take back to their classrooms. Overcoming teachers' misconceptions about physics.
6.	**EVALUATION MODEL**
	Pre/post-evaluation of teachers regarding science concepts. Evaluation of participants journal entries. Followup interviews with four teachers when they had returned to teaching.
7.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	Evaluation showed marked and significant changes in teachers concepts. Teachers also received grades for the course. Based on a "defined criteria" (not described in the report), 80% of the class received A's and 20% received B's. Journal entries indicated that teachers' changed their beliefs about physics and understanding about how physics can be taught in the elementary classroom. Also, teachers demonstrated a growing awareness of physics in the world around them.
B.	**CLASSROOM APPLICATION**
	In followup interviews, teachers reported that they had changed or increased their orientation in teaching science toward process and content and increased their awareness of the power of demonstrations and student-generated hypotheses.
8.	**COMMENTS ON EVALUATION**
	No followup observation or student outcomes used.
9.	**REFERENCE**
	Morehouse, R.E., Schenkat, R., and Battaglini, D. (1991). Confident in Content Through Conceptual Change. *Journal of Staff Development*, 12 (2), 34-38.

1. PROGRAM NAME AND SPONSOR

Comprehensive Program for Secondary School Teachers of Mathematics
National Science Foundation

2. TYPE OF PROGRAM

Over 4 years, a total of thirteen 6-week summer programs were held on several college campuses. Also, 20 off-campus inservice classes were conducted each semester during the school year, and special consultant and evaluation services were provided to 20 cooperating school systems. In addition, professional conferences were held in which supplementary training programs were prepared and a plan for the systemic evaluation of the program was developed.

Almost all of the program activities were built around the use of hands-on math games and activities for classroom use.

3. SCHOOL LEVEL

Secondary

4. NUMBER OF TEACHERS

Total of 1,451 teachers over the 4 years.

5. FOCUS

Designed to improve the mathematics achievement and attitude of secondary students and teachers in Arkansas.

6. EVALUATION MODEL

1. Evaluation of the project was directed toward the math competencies and attitudes of secondary students and teachers.
2. Teaching effectiveness measured by math achievement and attitude scores of the classes of teachers.
3. Students' achievement measured on the Cooperative Mathematics Tests.
4. Mathematics Attitude Inventory and Mathematics Opinionnaire measured student attitudes related to mathematics teaching.
5. Teacher knowledge of secondary math and attitudes toward math measured by the Massie Computer Math Test for teachers and an NSF-developed mathematics attitude inventory for teachers.
6. Compared students of participants with students of nonparticipants.

7. IMPACTS

A. PARTICIPANT SATISFACTION

Interest and enthusiasm for the program increased each year, with approximately 75% of secondary school math teachers participating to some extent, and many working towards master's degrees.

B. TEACHER KNOWLEDGE

Study report indicates that teacher knowledge was measured; no findings from this assessment were reported.

C. STUDENT OUTCOMES AND ACHIEVEMENT

There was an average difference of over 15% in achievement in algebra I between classes of program participants and nonparticipants from 1972-1976. Differences were significant at $p<.10$ level.

Results in geometry and general math showed a 10% difference, which was not significant.

Arkansas students as a whole had a positive attitude toward math as measured by the Statewide Attitude Scores.

School counselors reported that in one school where all 13 teachers had participated in program activities, math was selected as the favorite subject over all other subjects taught.

8. COMMENTS ON EVALUATION

Well-controlled and appropriate evaluation of program effectiveness. Data from all assessments cited were not reported, however.

9. REFERENCE

Orton, W. R. (1980). Report of a Four Year Statewide Mathematics Education Project. *School Science and Mathematics*. 80 (4), 309-16.

1. PROGRAM NAME AND SPONSOR

Science Education Leadership Institutes
NSF, Tennessee Dept. of Ed., and Tennessee Higher Education Commission.

2. TYPE OF PROGRAM

Five-year series of science education institutes that ran every other weekend for 3 hours Friday night and 6 hours on Saturday from January to June, and concluded with 4-6 weeks during the summer. Principals were included in the institutes as part of a 4-member team (with primary teacher, intermediate teacher, and the school's supervisor of instruction).

3. SCHOOL LEVEL

Elementary science

4. NUMBER OF TEACHERS

94 teachers, 47 principals, and 27 system supervisors.

5. FOCUS

Central involvement of the school principal as a coequal with teachers in a program of local leadership and science content enrichment through inservice education. Each team also worked with peer teacher for revision of the school's science program, and provided inservice instruction to other teachers on how to do hands-on science.

6. EVALUATION MODEL

Pre- and post-tests on teachers' instructional, curricular, and content knowledge and students' performance.

7. IMPACTS

A. TEACHER KNOWLEDGE

Significant overall gains in instructional and curricular skills and in content mastery.

B. LEADERSHIP AND EMPOWERMENT

Many participants list themselves as resource persons for inservice science program, and frequently contribute to programs and workshops at local, state, and national level.

C. STUDENT OUTCOMES AND ACHIEVEMENT

Significant gains in performance of students whose teachers had participated in the Leadership Institutes. Significant gains were also shown in the performance of students whose teachers had not participated but had received inservice training from a resource teacher who had participated. After 3 years of institute training, where participants became district leaders and trained other teachers, gains in performance were equally high for students directly taught by participants and for those taught by teachers who had been trained by participants.

8. COMMENTS ON EVALUATION

Good statement of hypotheses and goals of the program, and good evaluation using pre-/post-test data on teacher and student performance.

9. REFERENCE

Rhoton, J., Field, M.H., and Prather, J. P. (1992). An Alternative to the Elementary School Science Specialist. *Journal of Elementary Science Education,* 4 (1), 14-25.

1. PROGRAM NAME AND SPONSOR

Full Option Science System (FOSS)
NSF

2. TYPE OF PROGRAM

3-semester-hour university course in hands-on science.

3. SCHOOL LEVEL

Elementary

4. NUMBER OF TEACHERS

Twenty-nine 3rd-4th grade teachers, twenty-five 5th-6th grade teachers.

5. FOCUS

Hands-on, curriculum-based training course in concepts and processes in life science, physical science, earth science, and scientific reasoning and technology.

6. EVALUATION MODEL

Pre-tests and post-tests used to measure teachers' confidence toward teaching science, science content knowledge, attitude toward teaching science, and attitude toward science. Results were compared using a paired t-test.

7. IMPACTS

A. TEACHER KNOWLEDGE

Significant gains for both groups in teacher confidence toward teaching science, science content knowledge, and teachers' attitudes toward teaching science.

8. COMMENTS ON EVALUATION

Evaluators identified goals of program, used relevant measures, and found statistically significant differences in pre- and post-test measures.

9. REFERENCE

Robardey, C.P., Allard, D.W., and Brown, D.M. (1994). An Assessment of the Effectiveness of Full Option Science System Training for Third- through Sixth-Grade Teachers. *Journal of Elementary Science Education,* (1), 17-29.

1.	**PROGRAM NAME AND SPONSOR**
	Elementary Science Project NSF
2.	**TYPE OF PROGRAM**
	3-year project to implement a new science curriculum in 127 elementary schools that involved a 1-week summer institute.
3.	**SCHOOL LEVEL**
	Elementary
4.	**NUMBER OF TEACHERS**
	280
5.	**FOCUS**
	Establish a cadre of science trainers who will take a leadership role in the project; establish a core instructional framework for all grade levels; implement the new science curriculum; establish a materials center.
6.	**EVALUATION MODEL**
	Administered a survey to teachers before and after the training; collected self-report measures; classroom observations in randomly selected classes taught by teachers who received three different levels of training.
7.	**IMPACTS**
A.	**PARTICIPANT SATISFACTION**
	Surveys indicated a high level of satisfaction with the training.
B.	**TEACHER KNOWLEDGE**
	Teachers' responses to open-ended questions on post-training surveys indicated that their inquiry-based knowledge about science concepts was enhanced by training.
C.	**CLASSROOM APPLICATION**
	Lead (trained) teachers differed significantly from controls, in process behaviors (sorting/organizing) and "asking WH- questions" and the "guessing/estimating?" process. Lead teachers and teachers taught by them also differed in classroom strategies deemed valuable in supporting the inquire-based model.
D.	**LEADERSHIP AND EMPOWERMENT**
	Lead teachers were trained to impart knowledge to other teachers in the system. Evidence from classroom observations supported the effectiveness of this in certain areas observed.
8.	**REFERENCE**
	Saab, R.F., and Larson, J.C. (1995). *Evaluation of Teacher Training and Classroom Implementation for the National Science Foundation Elementary Science Project Academic Year 1993-94.* Montgomery County Public Schools, Rockville, MD.

1.	**PROGRAM NAME AND SPONSOR**
	Comprehensive Program for Science Teacher Education NSF
2.	**TYPE OF PROGRAM**
	Inservice program in science education at the University of South Dakota.
3.	**SCHOOL LEVEL**
	7-12
4.	**NUMBER OF TEACHERS**
	54
5.	**FOCUS**
	Develop the subject matter and mathematics competencies required to teach modern science courses.
6.	**EVALUATION MODEL**
	Pre- and post-test data in the following areas: Science subject matter competency; Participants' views about the nature of the science classroom and lab activities; Understanding of science; and Attitudes toward math, science, science teaching, and lab work. Also, pre- and post-test attitudinal data from participants' students.
7.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	Significant progress in subject matter competency. Teachers ranked in 90th percentile in the Test on Understanding Science when compared to the 1960 national sample of 12th graders.
B.	**CLASSROOM APPLICATION**
	Some positive but not significant changes in Science Classroom Activities Checklist.
C.	**TEACHER NETWORKING**
	Participants reported networking, but this was not evaluated specifically.
D.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	No change in attitudes toward science.
8.	**COMMENTS ON EVALUATION**
	Thorough evaluation using pre-/post-test design and significance tests.
9.	**REFERENCE**
	Sageness, R. L. (1974). *Comprehensive Program for Science Teacher Education Evaluation Report Number Two*. ERIC Document No. 114-286.

1. PROGRAM NAME AND SPONSOR

The Iowa Chautauqua Program

Sponsored by the National Science Teachers Association (NSTA) and the National Science Foundation. Also Eisenhower funding from the state and funding from the Iowa Utility Association.

2. TYPE OF PROGRAM

Inservice program with the following features:

- 2-week leadership conference for 30 teachers from previous years who are trained to become instructors for future workshops.
- 3-week summer workshop for 30 teachers to learn the Science/Technology/Society (STS) paradigm as defined by NSTA.
- Fall and spring followup workshops of 2 1/2 days, and a series of interim communications with staff, lead teachers, and fellow participants.

3. SCHOOL LEVEL

K-12

4. NUMBER OF TEACHERS

Over 1,900 K-12 teachers employed in nearly 300 of Iowa's 420 school districts. Initial focus was on teachers from grades 4 through 9.

5. FOCUS

1. Improve teacher confidence for teaching science.
2. Change the focus of teachers to make their teaching more congruent with the features of basic science.
3. Prepare science teachers as leaders who can help students improve in six domains of science education:
    a. Mastering basic content constructs;
    b. Learning the skills scientists use as they seek answers to their questions about the universe;
    c. Using concepts and processes in new situations;
    d. Improving quantity and quality of questions, explanations, and tests for validity of personally generated explanations;
    e. Developing more positive feelings concerning the usefulness of science;
    f. Assisting students with an understanding of and ability to use basic science.

6. EVALUATION MODEL

Teachers and students involved in the 1989-90 programs were evaluated and compared to a sample of applicants who did not participate in the program. Likert-type scales were used to evaluate their confidence to teach science and their understanding and use of the basic ingredients of science. These were administered prior to the workshop, after the spring workshop, and a year later. Also, observation and interviews with a school principal and a member of the workshop staff were used to validate the self-reporting scales. For Goal 3, pre- and post-tests were administered to all students of 15 lead teachers in 1989-90. Assessment information in six domains was collected from 722 students. Classes were randomly assigned to treatments.

7. IMPACTS

A. TEACHER KNOWLEDGE

Participants changed in their views of the nature of science and their ability to more frequently use and understand the features of basic science.

B. CLASSROOM APPLICATION

Participants were more successful in encouraging their students to use the basic ingredients of science.

C. LEADERSHIP AND EMPOWERMENT

Part of the program is to train lead teachers to become part of the instructional team for subsequent inservice workshops.

D. STUDENT OUTCOMES AND ACHIEVEMENT

Lead teachers in the program were more able to stimulate their students to grow significantly more in the process, applications, creativity, attitude, and world view domains (goals 3b-f) while not losing growth in the concept domain (goal 3a) when STS approaches are utilized than they could with student in non-STS classes. This evidence occurred with new teachers--but it was not as dramatic.

8. COMMENTS ON EVALUATION

This is a well-designed evaluation using treatment and control groups and pre- and post-test measures. Also, self-reports are supported by observation and interviews with other school staff.

9. REFERENCE

Science Education Center, *The Iowa Chautauqua Program: A Model for Effecting Change in the Teaching and Learning of Science in Schools.* The University of Iowa, Iowa City, Iowa 52242.

1. PROGRAM NAME AND SPONSOR

The Eisenhower Mathematics and Science Education Program (formerly the Education for Economic Security Act (EESA) Title II Program). Sponsored by the U.S. Department of Education.

2. TYPE OF PROGRAM

A large-scale federal initiative supporting professional development of the nation's math and science teachers. Virtually all school districts in the U.S. receive program funds either directly or through an intermediate unit or consortial arrangement. In addition, approximately 20% of all degree-granting institutions of higher education received one or more Title II grants.

3. SCHOOL LEVEL

All grade levels.

4. NUMBER OF TEACHERS

A estimated one-third of all math and science teachers in the nation took part in some kind of Title II-supported activity during the period of this evaluation, 1988-89.

5. FOCUS

There are three components to the program:

- State leadership activities (only 4% of program funds)
- Flow-through funding to school districts (two-thirds of funding - these support low-intensity inservice training (averaging 6 hours of training per participant per year), and out-of-district professional development.
- Grants to institutions of higher education (24% of funding) - these projects provide inservice teacher education, averaging 60 hours per participating teacher, pay more attention to content in addition to pedagogy, and more frequently focus on the needs of underrepresented groups.

6. EVALUATION MODEL

Four mail surveys, each with a response rate above 75%:

- A survey of 1,600 local education agencies;
- A survey of about 700 directors of higher education projects;
- A survey of all 50 state education agencies for elementary and secondary education;
- A separate survey of all state agencies for higher education.

Also, intensive study (involving site visits and interviews) with a sample of seven states representing a wide range of conditions.

Also, more than 100 teachers were interviewed as part of the study.

7. IMPACTS

A. PARTICIPANT SATISFACTION

The evaluation report indicated the teacher reactions were "overwhelmingly positive" about experiences in the Title II/Eisenhower-sponsored higher education activities. Similar findings were reported of teachers' experiences with inservice workshops at the local level.

B. TEACHER KNOWLEDGE

Teachers talked about gaining knowledge concerning hands-on or laboratory approaches to teaching science, use of manipulatives, integrating science into other areas of the curriculum, and cooperative learning groups.

C. CLASSROOM APPLICATION

The majority of higher education projects provide time and resources for participating teachers to develop math and science curricula.

D. TEACHER NETWORKING

Teachers "relished the contact with peers who had similar interests and enjoyed similar challenges."

E. LEADERSHIP AND EMPOWERMENT

Gaining self-confidence was a major theme in the teachers' comments.

Many projects require or suggest that participants return to their schools and conduct inservice workshops for their colleagues. Project directors estimate that each trained teacher has had at least some impact on four coworkers, for an outreach well beyond the original enrollees.

F. STUDENT OUTCOMES AND ACHIEVEMENT

Evidence of the impacts of these projects on students is largely anecdotal. Many teachers reported that their students' interest in science has escalated. Some drew causal connection between their participation in the inservice activities and improved performance of their students on tests.

G. MINORITY PARTICIPATION

On the average, higher education projects report that about one-fifth of participants (21%) are from minority backgrounds.

8. COMMENTS ON EVALUATION

Much of the reporting of impacts on teachers are general statements, supported by quotes from individual participants.

9. REFERENCE

SRI International (1991). *The Eisenhower Mathematics and Science Education Program: An Enabling Resource for Reform.* U.S. Department of Education, Office of Planning, Budget and Evaluation.

1. PROGRAM NAME AND SPONSOR

Madeline Hunter Instructional Theory into Practice (ITIP) Model
Follow-Through Project

2. TYPE OF PROGRAM

Two-year training program, including both periodic training sessions during the school year and followup visits by consultants; training also provided to principals.

3. SCHOOL LEVEL

Elementary, target on grades 1-4

4. NUMBER OF TEACHERS

11 teachers who remained in the two target schools over the 4-year course of the study

5. EVALUATION MODEL

a. Measures of program implementation included observational instruments to assess teacher practices, student engagement rates, and teacher questionnaires and interviews. Observations of instruction were carried out for two mathematics and two reading periods both before training and each spring following training. Students were observed on two days each spring. Teachers were interviewed each spring.

b. Student achievement was assessed using the Stanford Achievement Test in one school and the California Achievement Test in the second school. The tests were administered each spring.

c. Comparison schools were used for achievement comparisons in 1984-85.

6. IMPACTS

A. Classroom Application

Teacher behaviors changed in accordance with the ISOI model in years 1983 and 1984, but reversed in 1985.

B. Student Outcomes and Achievement

Student engagement increased in the first 2 years, but decreased between the second and third years.

Students test scores (for students who were in the study for all three assessment periods) increased from 1983 to 1984, but fell from 1984 to 1985. The gain in mathematics was only significant from year 1 to year 2. Treatment and control students did not differ in performance in 1985 when 1984 scores were controlled.

8. COMMENTS ON THE EVALUATION

The evaluation is well constructed using a multimethod approach and following teachers and students over several years. The data tend to support a relationship between training, changes in instruction, and changes in student achievement, but raise questions regarding factors affecting institutionalization of new practices, once supports are not provided.

9. REFERENCES

Stallings, J., Robbins, P., Presbrey, L., and Scott, J. (1986). Effects of Instruction Based on the Madeline Hunter Model on Students' Achievement: Findings from a Follow-Through Project. *The Elementary School Journal*, 86 (5), 571-586.

Stallings, J. and Krasavage, E. (1987). Program Implementation and Student Achievement in a Four-Year Madeline Hunter Follow-Through Project. *The Elementary School Journal*, 87 (2), 118-138.

1.	**PROGRAM NAME AND SPONSOR**
	University of California, Irvine, Summer Science Institute UCI Science Education Advisory Board, local school districts, and NSF.
2.	**TYPE OF PROGRAM**
	5-week summer program for science teachers.
3.	**SCHOOL LEVEL**
	Elementary, junior high, and secondary.
4.	**NUMBER OF TEACHERS**
	100
5.	**FOCUS**
	Update and revise the scientific knowledge of experienced teachers and to build a solid scientific foundation for "crossover" teachers who are teaching science without an adequate science background.
6.	**EVALUATION MODEL**
	Survey conducted during third week of classes.
7.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	88% agreed or strongly agreed that courses were increasing their understanding of basic concepts in science, and that they provided additional ideas for teaching science.
B.	**TEACHER NETWORKING**
	Contact with professors engaged in active research was a critical component of the institute's success. Continued contact between teachers and professors has resulted in programs such as Saturdays for Science, and the NSF-sponsored UCI Science and Math Mentor Teacher Program.
8.	**COMMENTS ON EVALUATION**
	Collaborative programs between faculty and teachers are a valued outcome. However, the report does not indicate how information about collaboration was gathered.
9.	**REFERENCE**
	Taagepera, M., Miller, G.E., and Benesi, A.J. (1985). The UCI Summer Science Institute. *Journal of Chemical Education,* 64 (3), 234-235.

1.	**PROGRAM NAME AND SPONSOR**
	U.S. Department of Energy Teacher Research Associates Program Department of Energy
2.	**TYPE OF PROGRAM**
	8-week summer research appointments to outstanding science, math, and technology teachers.
3.	**SCHOOL LEVEL**
	7-12
4.	**NUMBER OF TEACHERS**
	406 (18% minority)
5.	**FOCUS**
	Provides outstanding teachers the opportunity to participate in ongoing research projects at DOE laboratories. It is designed to encourage participants, upon returning to their home institutions, to share with their students and colleagues the experience and knowledge gained through the experience.
6.	**EVALUATION MODEL**
	Exit survey and followup survey (approximately 1 year later) and focus group evaluations that also took place approximately 1 year later.
7.	**IMPACTS**
A.	**PARTICIPANT SATISFACTION**
	Exit survey data indicated very high satisfaction with experience. On a scale of 1 (very dissatisfied) to 10 (very satisfied), 70% responded with a 9 or 10.
B.	**TEACHER KNOWLEDGE**
	Rated every aspect of their knowledge and understanding related to science and mathematics more positively after the program than before.
C.	**CLASSROOM APPLICATION**
	In the followup survey, 96% reported using program experiences in their teaching. This was substantiated in the focus group evaluations.
D.	**TEACHER NETWORKING**
	A consistent theme in the evaluation was that the program provides much-needed exposure to the world of scientific research.
E.	**LEADERSHIP AND EMPOWERMENT**
	In the followup survey, 99% said they had shared information from the program with their colleagues. This was substantiated in the focus group evaluations.
F.	**MINORITY PARTICIPATION**
	18% of participants were minorities.
8.	**REFERENCE**
	Vivio, F.M., and Stevenson, W.L. (1992). *U.S. Department of Energy Teacher Research Associates Program: Profile and Survey of 1990-1991 Participants.* U.S. Department of Energy.

1.	**PROGRAM NAME AND SPONSOR**
	National Science, History and Mathematics Leadership Program Woodrow Wilson Teacher Leadership Program
2.	**TYPE OF PROGRAM**
	1-week summer institute in science and math
3.	**SCHOOL LEVEL**
	Elementary and secondary
4.	**NUMBER OF TEACHERS**
	2,920
5.	**FOCUS**
	Develop teachers as leaders who can provide inservice education to other teachers.
6.	**EVALUATION MODEL**
	Followup questionnaire.
7.	**IMPACTS**
A.	**PARTICIPANT SATISFACTION**
	90% of participants rated the impact of the institute as moderate or higher.
B.	**TEACHER KNOWLEDGE**
	94% or more reported that attendance at the institute had increased their knowledge of content, application, and teaching techniques.
C.	**CLASSROOM APPLICATION**
	Over 93% reported increasing the use of demonstrations, laboratory experiments, or other practical activities.
D.	**LEADERSHIP AND EMPOWERMENT**
	98% reported that the institute increased their interest in professional growth. Over 70% had given at least some presentations to other teachers.
E.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	Over 90% reported an increase in students' interest in content and achievement.
8.	**COMMENTS ON EVALUATION**
	All results are from teachers' self-report only.
9.	**REFERENCE**
	Webb, N. *Impact of the National Science, History and Mathematics Leadership Program 1992 Summer One-week Institutes*. Brief report sent by author.

1.	**PROGRAM NAME AND SPONSOR**
	Summer Science Institute at the University of Delaware Funded with Title II funding for equipment and materials.
2.	**TYPE OF PROGRAM**
	Month-long summer program in science education. Inservice workshop for district teachers conducted by summer institute teachers.
3.	**SCHOOL LEVEL**
	K-3
4.	**NUMBER OF TEACHERS**
	10
5.	**FOCUS**
	Improve background knowledge of light and shadows and develop, teach, and revise a unit on the topic. Goal was to reduce perceived obstacles to teaching science.
6.	**EVALUATION MODEL**
	Teachers' logs, final reports, and pre- and post-institute interviews.
7.	**IMPACTS**
A.	**PARTICIPANT SATISFACTION**
	Teachers reported feeling more confident about teaching science to children. They also felt it was an excellent and worthwhile experience.
B.	**CLASSROOM APPLICATION**
	Teachers reported that their participation in the institute had helped them improve their science teaching, especially in the areas of how to teach and how to manage a class while teaching science. The initial problem with finding enough time to teach science did not improve after the institute. But teachers were now making more time for science, "no matter what."
8.	**COMMENTS ON EVALUATION**
	Evaluation based on self-report taken before the institute and after a year of teaching following the institute. No other measures were used.
9.	**REFERENCE**
	Weir, E. A. (1988). *Breaking Down Barriers to Teaching Primary Science: Did a Summer Science Institute Help?* ERIC Document No. 292-686.

1.	**PROGRAM NAME AND SPONSOR**
	NSF Teacher Enhancement Projects
2.	**TYPE OF PROGRAM**
	An evaluation of 47 NSF projects in math and science teaching.
3.	**SCHOOL LEVEL**
	Elementary and secondary
4.	**NUMBER OF TEACHERS**
	47 principal investigators and 35 teachers were interviewed.
5.	**FOCUS**
	This evaluation was an attempt to determine the impact of selected NSF teacher enhancement projects by Horizon Research, Inc. The programs are designed to improve science and mathematics teaching by upgrading content knowledge, improving teaching methods, and increasing the use of technology in the classroom.
6.	**EVALUATION MODEL**
	Interviews with PIs and teachers; reports and other documents about the impact of the projects from the projects themselves.
7.	**IMPACTS**
A.	**TEACHER KNOWLEDGE**
	Both PIs and teachers reported increased teachers' knowledge of math, increased confidence, improved pedagogical skills, and use of technology.
B.	**CLASSROOM APPLICATION**
	Teachers reported changes in their classroom behavior, but few of the projects had done any systematic observation of their teachers. Teachers also reported that they developed curriculum materials that were being used at the state and district level.
C.	**TEACHER NETWORKING**
	Teachers reported that participating in some of the projects had an impact on reviving the enthusiasm that teachers felt for teaching and in alleviating their sense of isolation from other professionals.
D.	**LEADERSHIP AND EMPOWERMENT**
	PIs and teachers reported that teachers had taken on leadership roles at their schools. They also reported increased participation in professional activities.
E.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	Teachers reported that students express greater enthusiasm for their subjects.
8.	**COMMENTS ON EVALUATION**
	This was a qualitative evaluation of several NSF projects, based on teachers' self-report and the impressions of principal investigators.
9.	**REFERENCE**
	Weiss, I.R., Boyd, S.E., and Hessling, P.A. (1990). *A Look at Exemplary NSF Teacher Enhancement Projects*. Horizon Research, Inc.

1.	**PROGRAM NAME AND SPONSOR**
	NSF Comprehensive Teacher Training Projects
2.	**TYPE OF PROGRAM**
	NSF institute in science and math (no detailed description provided in the review.)
3.	**SCHOOL LEVEL**
	Junior and senior high
4.	**NUMBER OF TEACHERS**
	346 science, 211 math
5.	**FOCUS**
6.	**EVALUATION MODEL**
	Students were randomly selected from the treatment group and from a control group and given science achievement tests. Chi square and ANCOVA were used to analyze data.
7.	**IMPACTS**
A.	**STUDENT OUTCOMES AND ACHIEVEMENT**
	NSF participation was found to be a significant factor in student achievement for high school science and math teachers but not for junior high school teachers.
8.	**COMMENTS ON EVALUATION**
	Reasonable study with good control of variables.
9.	**REFERENCE**
	Willson, W.L., and Garibaldi, A.M. (1974). *The Effect of Teacher Participation in NSF Institutes Upon Student Achievement.* ERIC Document No. 161-680.